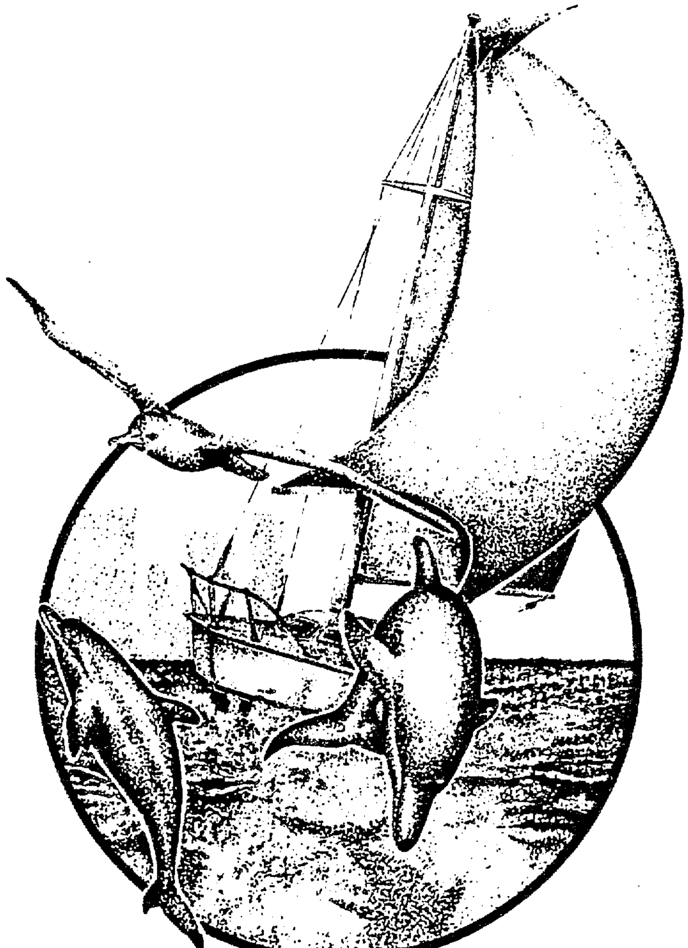
CM-120

F1. Department of Environmental Regulation



BISCAYNE BAY AQUATIC PRESERVE MANAGEMENT PLAN

DRAFT

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BISCAYNE BAY AQUATIC PRESERVE
MANAGEMENT PLAN

Preparation of this plan was financed in part through grants CM-60, CM-94 and CM-120 through the Office of Coastal Management, Florida Department of Environmental Regulation pursuant to the Coastal Zone Management Act of 1972, as amended.

September 30, 1986

BISCAYNE BAY AQUATIC PRESERVE MANAGEMENT PLAN

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PREFACE

BISCAYNE BAY AQUATIC PRESERVE MANAGEMENT PLAN

Biscayne Bay is a shallow 275 square mile subtropical lagoon, which is approximately 40 miles long and extends the length of Dade County, Florida. During the past eighty years, dredge and fill activities, the creation of channels and cuts, flood control practices, the intensity and location of shoreline development and resource use have substantially altered the character and quality of Biscayne Bay.

Background

Dredging and filling has destroyed thousands of acres of coastal communities since the turn of the century. Mangroves, once considered valueless, smelly, mosquito-infested nuisances were early targets for wholesale destruction. It has been estimated that there were approximately 46,000 acres of mangroves in Dade County in 1900. By 1972 that acreage had been reduced to approximately 10,500 with only about 1,800 acres remaining north of Coral Gables (Teas, 1974). Since mangrove forests contribute to the marine food web and provide shoreline stabilization, buffering against storm tides, filtration of overland runoff, nursery grounds and wildlife habitats, their destruction resulted in significant resource losses.

As dramatic as the destruction of shoreline mangrove communities has been, it is equally important to appreciate the effects of dredge and fill activities on submerged Bay bottom communities. Left to grow or recolonize, seagrass roots bind and stabilize sediments. This contributes appreciably to the maintenance of water clarity. Seagrasses also cycle elements through the ecosystem by absorbing them from the sediments, storing and reconverting them into useable organic substances. In addition, several hundred species of fish and invertebrates inhabit seagrass flats at some time during their life cycle. Notable examples include shrimp, spiny lobster, mullet, snappers, grunts, sea trout, bonefish and permit. Since 1900, over 40 percent of the submerged area north of Rickenbacker Causeway has been permanently altered through dredging and filling and the construction of more than 90 miles of bulkheaded shoreline, channels, cuts to the ocean, artificial islands and causeways.

The impact of these changes was exacerbated by the construction of the south Florida water management system. In the early 1900s, freshwater flowed from the Everglades through natural drainage-ways in the coastal ridge into Biscayne Bay during the rainy season. In the dry season, freshwater seeped through the porous limerock, called the Biscayne Aquifer, into the Bay. With the construction of levees and canals, water conservation areas and flow regulation structures, both the volume and the duration of freshwater flows into the Bay were substantially decreased. Prior to 1900 freshwater springs bubbled up in the Bay almost a mile from shore. Today water seeping into the Bay from the aquifer along the shoreline is no longer completely fresh.

In addition to the alterations in hydroperiod and salinity regimes, the extensive south Florida canal network has, in effect, turned the Bay into a disposal area for upland runoff. Today more than 900 storm water outfalls greater than 12 inches in diameter carry runoff with various pollutants directly into canals and the Bay.

Prior to 1970 parts of Biscayne Bay and many of the canals in Dade County were polluted by millions of gallons of raw or poorly treated sewage. In 1973, 33 out of the 94 wastewater treatment facilities then operating in the County discharged more than 24 million gallons of treated effluent into the canals in Dade County daily, and more than 40 percent of the County population was using septic tanks (Dade County Water Quality Management Plan, 1983).

Responses

Between 1973 and 1983 the capacity of sewage treatment plants in the County increased from 117 million gallons per day to an average of 222 million gallons per day and the degree of treatment increased substantially. By 1984, approximately 83 percent of the County's sewage effluent was discharged via ocean outfalls, 15 percent was injected into deep wells, and two percent was discharged into soakage pits, drain fields and canals.

In south Biscayne Bay the threat of development of a large oil refinery ultimately lead to the creation of Biscayne National Monument in 1968. In June 1980 Congress redesignated Biscayne National Monument as a National Park and authorized funds for expansion of the former monument boundaries to the north and west. Biscayne National Park now includes 181,500 acres. The Park encompasses two-thirds of Biscayne Bay including the Safety Valve, the upper Keys from Broad Creek north to Soldier Key and the mangrove fringe forest on the mainland. As this area is monitored and protected by the National Park Service, it is excluded from this plan.

During the 1970s, concern over the condition of Biscayne Bay was expressed at a number of conferences and symposia. There was general consensus that the first step toward solving many of the Bay's problems should be the development of a comprehensive plan to protect the Bay and to simplify the fragmented, overlapping maze of jurisdictional control over the Bay and adjacent shoreline.

In 1974 the Florida Legislature established the Biscayne Bay Aquatic Preserve (Figure 1), including all publicly owned islands and all submerged lands from the Sunny Isles Causeway (State Road 826) on the north to Card Sound Road (State Road 905A) in Monroe County to the south, excluding Biscayne National Park. The western boundary of the Biscayne Bay Aquatic Preserve runs along the mean high water lines of Biscayne Bay and Card Sound. The eastern boundary runs along the mean high water line on the western shores of the upper keys, Key Biscayne, Virginia Key, and Miami Beach; and imaginary lines connecting the closest points on the adjacent islands.

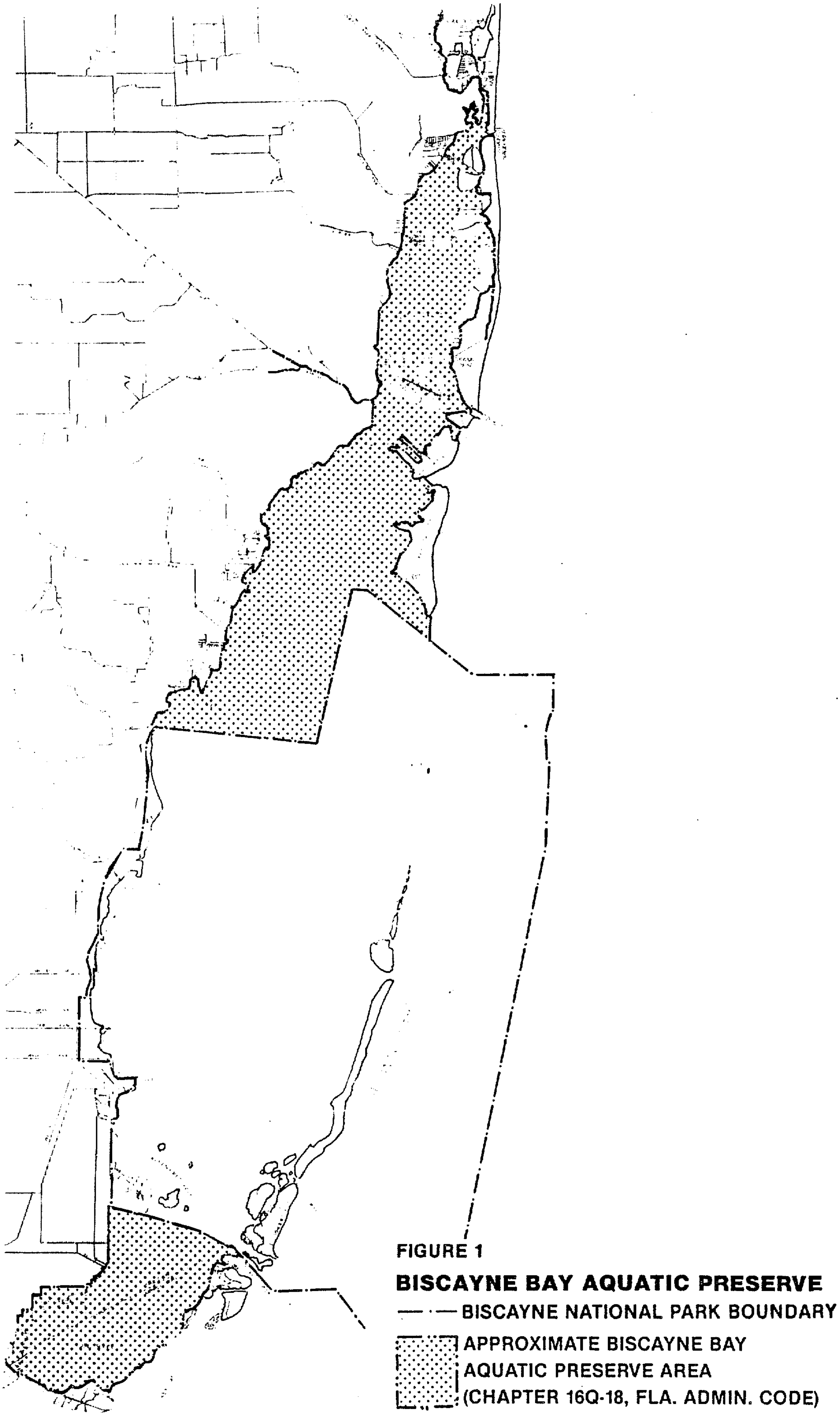
FIGURE 1
BISCAYNE BAY AQUATIC PRESERVE
BISCAYNE NATIONAL PARK BOUNDARY
APPROXIMATE BISCAYNE BAY AQUATIC PRESERVE AREA (CHAPTER 16Q-18, FLA. ADMIN. CODE)

The Preserve also includes the Oleta River; Arch and Little Arch Creeks from the Bay to their salinity control structures; Little River to salinity control structure S-27; the Miami River to the salinity control structure S-26; the South Fork of the Miami River (Comfort Canal) to salinity structure S-25; the Tamiami Canal from the Miami River to salinity structure S-25B; Indian Creek south to and including Lake Pancoast, but excluding Collins Canal; Coral Gables Waterway to LeJeune Road; and Snapper Creek to the salinity structure S-22. All privately owned uplands within the area described and Biscayne National Park are excluded from the Biscayne Bay Aquatic Preserve.

In addition to the establishment of the State Aquatic Preserve the Board of County Commissioners declared Biscayne Bay an "Aquatic Park and Conservation Area" in 1974, and empowered the County Manager to develop a Bay plan. Developed during 1979-80, the County's Bay plan identified management responsibilities and outlined an approach "to provide a unified management system for the entire bay system that will, upon implementation, effectively maintain and enhance those physical, chemical, biological and aesthetic qualities that provide the basic character and values of this resource." At the time of adoption in 1981, the Board of County Commissioners also established the Bay Management Committee to oversee progress toward implementing the programs recommended in the Bay plan.

Pursuant to the Biscayne Bay Aquatic Preserve Act, the State of Florida has appropriated more than two and one-half million dollars since 1978 for Biscayne Bay restoration and enhancement. These funds have provided the main support for Bay management programs. The activities funded by the State monies include: development of a comprehensive data base, improvement of in-water and shoreline habitats, and improving public access to the Bay.

In developing this Plan, data that had been compiled or generated since 1980 were used to update and expand information that had been used in the development of the Bay Management Plan in 1979-80. An advisory committee of interested citizens was established to review all components of this Plan.

The program to improve the data base began in 1979 with the initiation of a Bay-wide water chemistry sampling program. Studies have also been undertaken to improve our understanding of the Bay bottom communities, sport and commercial fisheries, circulation patterns, sources of turbidity and sediment chemistry. As the data base for the Bay was being developed and evaluated, Metro-Dade County sought and obtained in November 1983, a management agreement with the State that encouraged the County to develop a management plan and criteria for the area of the Biscayne Bay Aquatic Preserve north of Biscayne National Park.

Biscayne Bay Aquatic Preserve Management Plan

While the Preserve includes submerged lands within Card Sound, the Aquatic Preserve Management Area (APMA) covered by this plan only includes the 72 square miles of submerged lands and publicly owned islands between the northern boundary of Biscayne Bay National Park and the Sunny Isles Causeway. The APMA also includes the lands below mean high water in nine tributaries (Figure 2).

Because of funding constraints this project was done in three phases. Phase I included the Overview Chapter I, the area from Julia Tuttle Causeway south to the Rickenbacker Causeway, and the Miami River and its natural tributaries to their respective salinity structures. Phase II, included the area from Sunny Isles Causeway to the Julia Tuttle Causeway and Phase III included the areas between the Rickenbacker Causeway and the northern boundary of Biscayne National Park.

Chapter 1 includes a description of the north, central, and south Bay areas, a summary of the geological history, and a section on the human history and other factors which have influenced the Bay. This chapter includes a general overview of the recent scientific studies on the physical and chemical characteristics of the Aquatic Preserve Management Area plus descriptions of factors that affect the quality and utility of that area. Chapter one concludes with a summary of Federal, State, County, and municipal laws that are relevant to Biscayne Bay Aquatic Preserve management and general recommendations for the APMA.

Chapters two through nine describe each of the basins, or units, within the APMA, including the area from Sunny Isles Causeway to the Broad Causeway and the Oleta River (Chapter 2); the area between Broad and the 79th Street Causeways (Chapter 3); the basin from 79th Street to the northern edge of the Julia Tuttle Causeway (Chapter 4); the basin area from the Julia Tuttle Causeway to the Venetian Causeway (Chapter 5); the area from the Venetian Causeway to the Port of Miami (Chapter 6); the basin area from the Port of Miami to the Rickenbacker Causeway (Chapter 7); and the area between Rickenbacker Causeway and the northern boundary of Biscayne National Park (Chapter 8). Each chapter includes a description of the physical conditions, shoreline uses, in-water activities, submerged land uses, and submerged land ownership. Management opportunities for each area are described at the conclusion of these Chapters.

Chapter 9 describes factors that affect the quality and utility of the Miami River and its tributaries to the salinity dams east of 42 Avenue. This chapter was written in conjunction with the work of the Miami River Management Committee and its successor, the Miami River Coordinating Committee. This chapter concludes with recommendations to improve the quality and utility of the River.

Coastal Zone Management Grants (CM-60, CM-94 and CM-120) have partially funded the development of this Plan. Under the terms of those grants and the management agreement between Metro-Dade County and the State of Florida, this Plan will be submitted to the Biscayne Bay Management Committee. Upon the Bay Management Committee's review and recommendation, the Plan will be submitted to the Board of County Commissioners of Metropolitan Dade County and to the Governor and Cabinet of the State of Florida, sitting as the Trustees of the Internal Improvement Trust Fund.

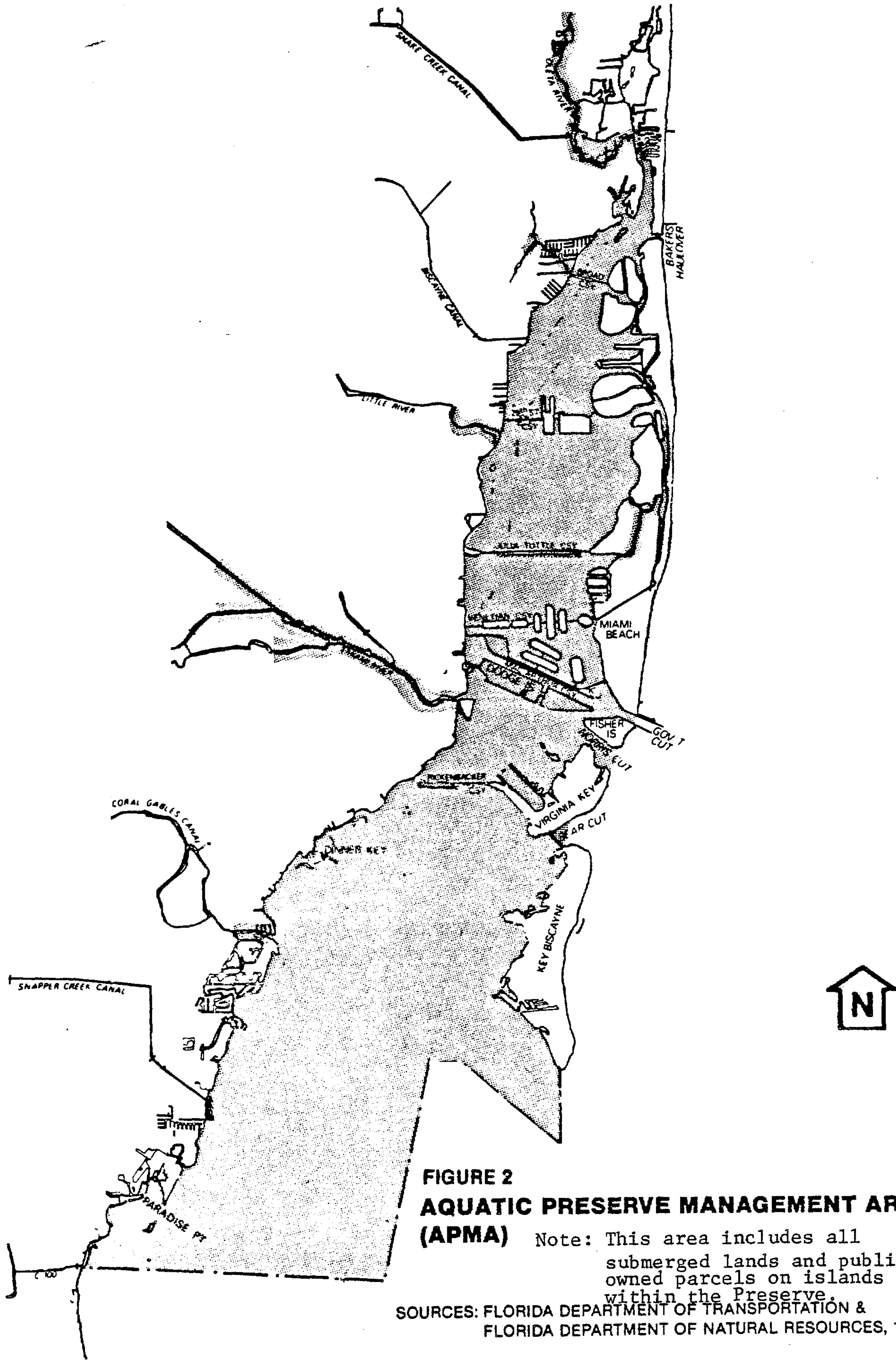

FIGURE 2
AQUATIC PRESERVE MANAGEMENT AREA (APMA)

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION & FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

ACKNOWLEDGEMENTS

The following individuals served on an Advisory Committee for this project. Their patience in reviewing successive drafts and contributions to this project are gratefully acknowledged. Their affiliations are listed for identification purposes only.

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Cathy Swanson, City of Miami
John Thomas, Admiralty Lawyer, Marine Council
Brian Young, City of Miami Beach Code Enforcement

CHAPTER I

OVERVIEW OF THE BISCAYNE BAY AQUATIC PRESERVE MANAGEMENT AREA

PART I

ENVIRONMENTAL SETTING

DESCRIPTION

Biscayne Bay is a shallow, subtropical lagoon averaging six feet in depth. The Bay is a fairly recent geological formation. It is elongated in shape, and located in a north/south trending direction on the southeastern coast of the Florida peninsula (see Figure 3). Biscayne Bay has traditionally been divided into three regions; north, central and south Bay (see Figure 4). The distinctions between each region are based on the physical and natural characteristics, the surrounding shoreline and its attendant physical development.

NORTH BISCAYNE BAY

North Biscayne Bay extends from the Sunny Isles Causeway to the Rickenbacker Causeway. It is bordered on the east by the barrier islands of Miami Beach, Fisher Island and Virginia Key and by the predominantly residentially developed mainland shore and the Miami central business district. Urban development and the construction of causeways and the Port of Miami have subdivided the fourteen mile long north Bay area into seven basins or units (see Figure 5), varying in width from a few hundred feet just south of the Sunny Isles Causeway to over three and one half miles north of the Julia Tuttle Causeway.

Like central and south Bay, north Bay is a naturally shallow waterbody, with average depths about six feet at mean low tide. However, over 20 percent of the north Bay area has been dredged creating, in effect, a 27 square mile urban aquatic park. The deepest areas in north Bay are the borrow pit north of the Julia Tuttle Causeway and the Government Cut Channel which have been dredged to 26-29 feet and 40 feet, respectively. Although the basin between the Port of Miami and Rickenbacker Causeway (Unit VII) is more hydrologically related to central Bay than to north Bay (van de Kreeke and Wang, 1984), this basin is included in the north Bay or North Preserve Management Area (NPMA) in this plan.

CENTRAL BISCAYNE BAY

Central Bay, sometimes referred to as mid-Bay, is bounded on the north by the Rickenbacker Causeway and on the south by an imaginary line drawn from Black Point through the Featherbed Banks to the cut between Boca Chita and Sands Keys. Central Bay is bounded on the east by Key Biscayne, the nine mile long network of shoals and channels south of Key Biscayne called the Biscayne Flats or the Safety Valve, Soldier Key, the five Ragged Keys and Boca Chita Key. On the west, this area is bordered by the mainland cities of Miami and Coral Gables.

The 112 square mile central Bay area differs both qualitatively and quantitatively from north Biscayne Bay. Here the Bay reaches its maximum width of 10 miles and its maximum natural depths of 13 feet. There is free exchange with ocean waters in this area across the Safety Valve.

The mainland shoreline rises sharply from a shallow submerged platform to the Atlantic Coastal Ridge immediately inland from the shore. The shoreline from the Rickenbacker Causeway to the Coral Gables city limit is mostly developed in residential estate and open space uses. Prominent

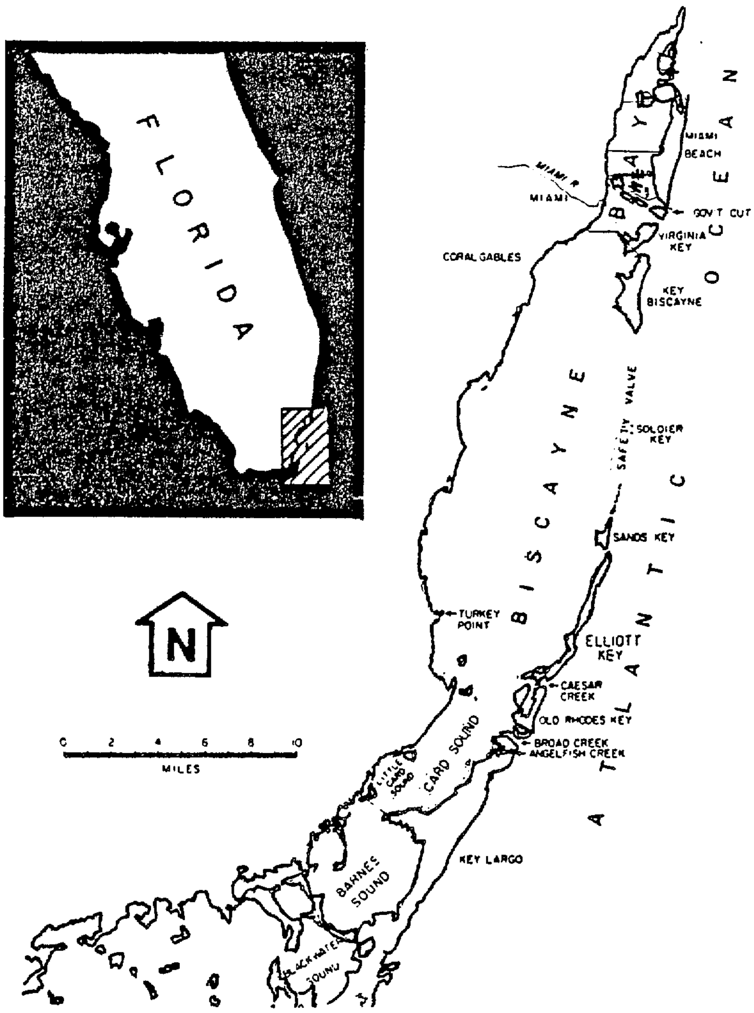


FIGURE 3

LOCATION OF BISCAYNE BAY

SOURCE: MODIFIED FROM HOFFMEISTER, 1974

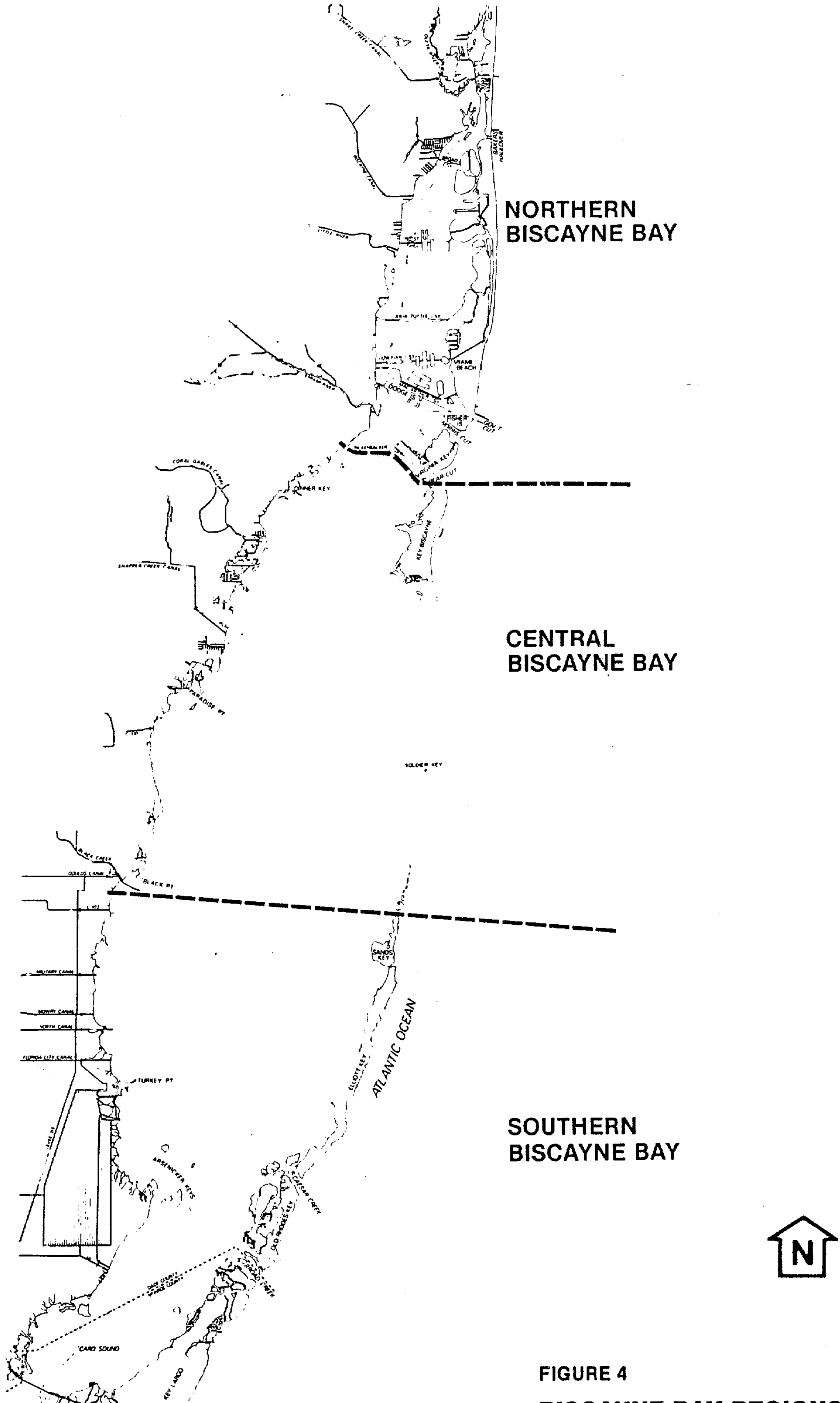


FIGURE 4

BISCAYNE BAY REGIONS

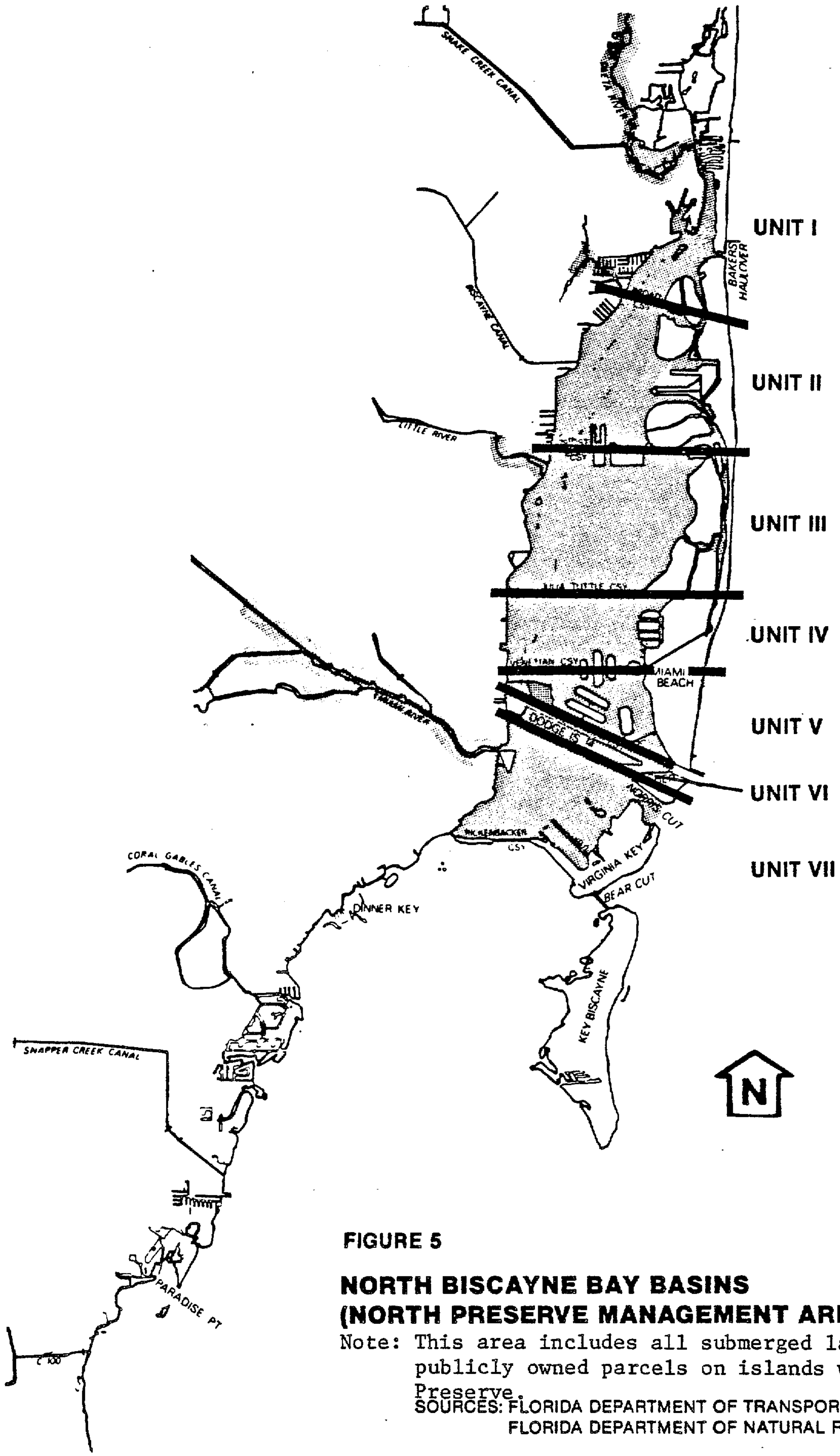


FIGURE 5

NORTH BISCAYNE BAY BASINS
(NORTH PRESERVE MANAGEMENT AREA-NPMA)

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION & FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

high rise structures in Coconut Grove and along the Coral Gables Waterway present sharp contrasts to the otherwise low, landscaped, vegetated shoreline. From Matheson Hammock Park south to Black Point the shoreline consists primarily of mangroves. In the northeast portion of central Bay, the apartments and hotels on Key Biscayne rise sharply above the mangrove shoreline.

Sixty percent of the central Bay area is within Biscayne National Park. The only portion of central Bay that is addressed in this plan is the Central Preserve Management Area (CPMA) between the northern boundary of Biscayne National Park and Rickenbacker Causeway. The CPMA encompasses approximately 45 of the 112 square mile central Bay area (see Figure 6).

SOUTH BISCAYNE BAY

Located south of the imaginary line drawn across the Bay from Black Point to the cut between Boca Chita and Sands Keys, south Bay differs from central and north Biscayne Bay. The mainland is lined with mangroves, and the stacks at the Turkey Point power plant are the only visible man-made features. In south Bay, both access to the offshore areas and water circulation are restricted by the presence of islands (or keys) with few tidal inlets. As in central Bay, there is an exposed shallow ledge of limestone adjacent to the western shoreline, where water depths are less than six feet at low tide; but in south Bay the submerged ledge extends more than three or four miles from shore and generally supports lush seagrass and hard bottom communities.
The mainland shoreline rises more gradually than in the central or northern Bay regions. South of Black Point, most of the shore land registers elevations of only one or two feet above mean sea level for a mile or more inland from shore. South Bay is included in Biscayne National Park and is, therefore, excluded from this Plan.

GEOLOGICAL HISTORY

Biscayne Bay is a partially filled depression in the Pleistocene limestone surface of southern Florida (Wanless, 1984). The ridges which enclose the Bay were formed about 100,000 years ago when the seas were approximately 25 feet higher than at present. On what is now the mainland, minute calcium carbonate spheres accumulated and eventually formed the oolitic (Miami Limestone) ridge known as the Atlantic Coastal Ridge.

The eastern boundary of Biscayne Bay is formed by a ridge of Pleistocene coral reef (Key Largo) limestone (Wanless et al 1984). This ridge forms the upper keys and continues northward as the submerged base structure of the Safety Valve and the barrier island of Miami Beach; and lies just seaward of Key Biscayne, Fisher Island and Virginia Key (Wanless et al 1984). Originally deposited as a reef during the late Pleistocene era, the ridge was later exposed and hardened. Now buried beneath the Safety Valve and Miami Beach, this ridge played an important part in positioning and stabilizing sediments on Miami Beach and in Biscayne Bay (Wanless et al 1984).

About 6,000 years ago, during the most recent rise in sea level, Biscayne Bay began to fill with seawater. Sediments consisting of quartz sand,

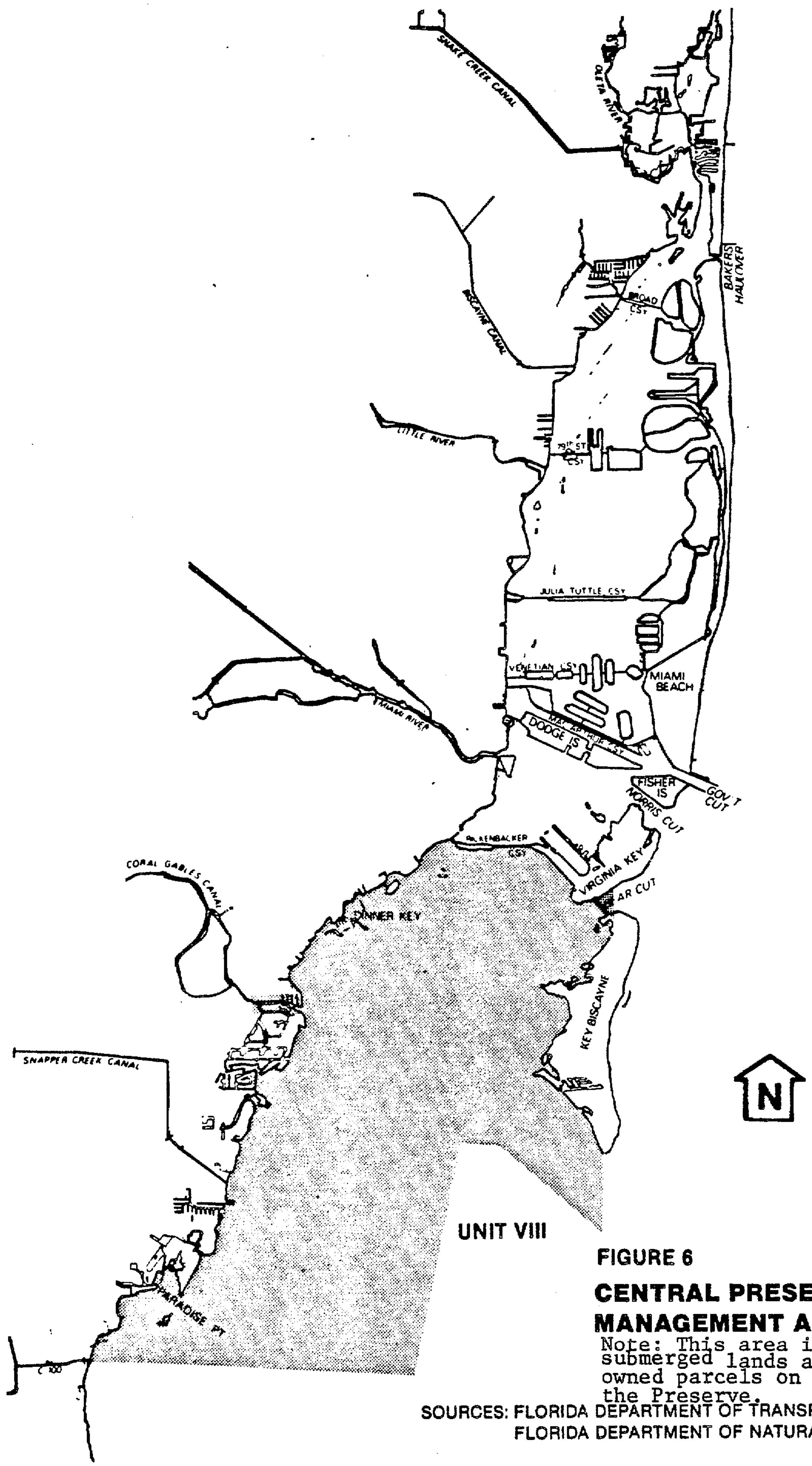


FIGURE 6

CENTRAL PRESERVE MANAGEMENT AREA (CPMA)

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION & FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

carbonate shell sand, carbonate mud and organic materials, began to build up and cover the limestone surface (Harlem, 1979). About 5,000 years ago, north Biscayne Bay started to become enclosed as quartz and carbonate sands from the mid-Atlantic coast drifted southward forming the barrier islands of Miami Beach, Virginia Key and Key Biscayne. The only permanent natural tidal inlet through these barriers was Bear Cut (Wanless et al, 1984).

About 4,000 years ago the Safety Valve banks of carbonate sand and mud began to form a shallow bank running from the Miami Beach barrier island to the upper Keys just west of the Key Largo Limestone Ridge which became submerged by the rising sea. Mangroves bordered almost the entire coastline of the Bay. With subsequent elevation in sea level, both the mangrove swamps and barrier islands were inundated. The sediments already deposited were exposed to more wave and current energy, and the Bay and its tidal inlets enlarged. When the rise in sea level slowed dramatically some 3,200 years ago, sediments were once again able to accumulate. The Safety Valve was able to trap locally produced sediments and the Bay became protected from rapid inundation of seawater and constant changes in hydrography (Wanless et al, 1984).

Unlike some other coastal lagoons along the Atlantic and Gulf Coasts, Biscayne Bay is not a drowned river valley with a steady, heavy input of sediment. Rather, sedimentary processes are controlled by the rigid topography of the basin, the availability of sediment, and wind driven circulation, primarily during periods of winter cold fronts and hurricanes. Here the confined limerock basin not only defines where sedimentation can occur, but also limits the amount of available sedimentary material. Except for the limited longshore drift of quartz sand along the barrier island beaches, essentially all of the Bay's sediments are produced by organisms living within the Bay itself (Wanless, 1976).

The limestone bottom of the Bay was covered with varying thicknesses of sand and muds. They were thickest in the eastern area of the Bay at the Safety Valve and beneath the barrier island system (Harlem, 1979). Depths in Biscayne Bay were generally shallow, averaging about 6 feet. Some tidal channels and the area south of the Miami River were as deep as 9 feet. According to Harlem (1979), "The Bay bottom was shallowest along the eastern Bayshore (except in the tidal channels), in the cross-Bay shoal running east-southeast from Little River and along the western shore south of the Miami River."

OTHER INFLUENCING FACTORS

Together with geology, climate has molded the shape of the land and drainage characteristics in south Florida. Each of the climatic elements of rainfall, sunlight, temperature, and winds has influenced Biscayne Bay.

CLIMATE

South Florida is characterized by a subtropical marine climate, consisting of long warm summers with abundant rainfall and prevailing east to southeast trade winds. The winters are generally mild and relatively dry. Arctic air masses in the form of cold fronts pass through the area during the months of November to April while tropical depressions and storms generally occur in the summer time.

Sunlight

The Bay area is strongly influenced by its geographical location. Due to the proximity to the equator, this area receives intense sunlight during two-thirds of the daylight hours. While the attendant thermal effects are moderated by the presence of the Gulf Stream and southeast trade winds, this intensity of sunlight is a primary factor in the Bay environment and in maintaining the balance of plants and animals in this shallow subtropical lagoon (Metro-Dade County Planning and DERM, 1981).

Temperature

Air temperatures around the Bay area are moderate. On the average temperatures in the coastal areas are milder and are less extreme than inland temperatures. Summer air temperatures average 82°F and rarely exceed 95° or fall below 70°; with winter temperatures averaging 68°F and rarely going below 35°F. While temperatures do drop below freezing for several hours every few years, it is extremely rare that freezing temperatures remain in the Bay area for significant periods of time (Wanless et al, 1984) but it is the extremes in air temperature that have the most effect on Bay water temperatures. Passing winter cold fronts have been known to cause 18°F drops in the Bay water temperatures within a twenty-four hour period (Metro-Dade County Planning and DERM, 1981).

Bay water temperatures average 66.2°F in the winter with a minimum of 48°F, and average 87°F in summer with a maximum of 95°F. The shallow Bay waters often exhibit a 5.4°F day-night variation (Metro-Dade County Planning and DERM, 1981). Temperature exerts a 'push' and 'pull' force on the Bay system. With moderate increases, accelerated respiration and productivity and cycling of material through the system are observed. However, when temperatures increase significantly above background, the system is stressed until it ultimately ceases to function. Optimal temperatures for maintaining species diversity and maximum biomass in Biscayne Bay range between 62° and 82°F. At water temperatures between 82°F and 92°F, 50 percent of the organisms are killed; and between 95°F and 98°F, 75 percent of the organisms die (Bader and Roessler, 1972).

Rainfall and Hydrology

The south Florida area usually receives more rain between June and October than any other area of the country. About 70% of south Florida's total annual rainfall occurs during these five months. Winter rains are scarce and mostly associated with the passage of cold fronts. Most of the summer rainfall occurs as localized showers which have a high intensity over only a few square miles. Early morning rainfall is more likely to occur along the coast, while afternoon rainfall is more likely to occur inland (Metro-Dade County Planning Department, 1979). However, the average annual Bay area rainfall of 50-65 inches varies markedly from area to area, as well as seasonally and annually (Wanless et al, 1984).

Extremes in recorded yearly rainfall totals have ranged from 40 to 85 inches.

Rainfall and hydrological patterns influence salinity within the Bay system. Historically, during the rainy season, freshwater flowed into the Bay through rivers, creeks, broad natural sloughs, groundwater seepage and underground springs. This freshwater slowly mixed with seawater and a region of mildly salty, or brackish water was maintained throughout many months of the year along the western shore of the Bay.

The creation of canals and levees to drain the interior wetlands and provide flood protection accelerated the rate of freshwater input into the Bay, but concentrated the flow into smaller areas and decreased the total amount of freshwater flowing into the Bay by about 20 percent (Buchanan and Klein, 1976). Today, thirteen major canals discharge freshwater into Biscayne Bay. The Oleta River, Snake Creek Canal, Biscayne Canal, Little River Canal and the Miami River Canal discharge directly into the NPMA. The Gables Waterway Canal, Snapper Creek Canal and Canal-100 discharge water into the CPMA. All of the canals from Snapper Creek north were initially dredged in the 1910s and 1920s.

Rainfall, groundwater seepage and canal outflows dilute the seawater along the western Bay shoreline during the rainy season. This causes the formation of a salinity gradient which increases from brackish near the mainland shore to seawater on the Ocean side of the Bay (Van de Kreeke, 1984). Salinities in north Bay generally range from a low of 20 parts per thousand (ppt) to seawater (35 ppt), with extreme lows of three ppt at the mouths of canals (see Figures 7 and 8). Salt concentrations higher than those found in normal seawater are not uncommon during the dry season in central and southern Biscayne Bay. The east/west salinity gradients are important because many kinds of fish and shell fish are adapted to areas of lowered salinity, especially during their juvenile stages.

Winds, Winter Storms, Tropical Storms and Hurricanes

South Florida's prevailing winds are generally out of the east or south-east, and are generally less than 12 mph 60 percent of the time. Average wind speeds along the coastal areas are two times stronger than those measured inland (Metro-Dade County Planning Department, 1979).

During the winter months the prevailing easterly breezes are interrupted on an average of once a week by cold fronts with an increase in wind speed and a clockwise rotation of wind direction. Ahead of these fronts, maximum wind speeds come from the southwest; maximum winds behind the fronts come from the northwest and north. The fronts play an important role in the resuspension, circulation and deposition of fine grained sediments in Biscayne Bay (Wanless et al, 1984).

In the summer the prevailing winds are interrupted by high winds of short duration associated with local thunder storms (Wanless, 1984). Sustained high winds are associated with tropical storms and hurricanes. Tropical storms (winds from 38-73 mph), hurricanes (74-123 mph) and great hurricanes (over 124 mph) are cyclonic storms containing a low pressure and

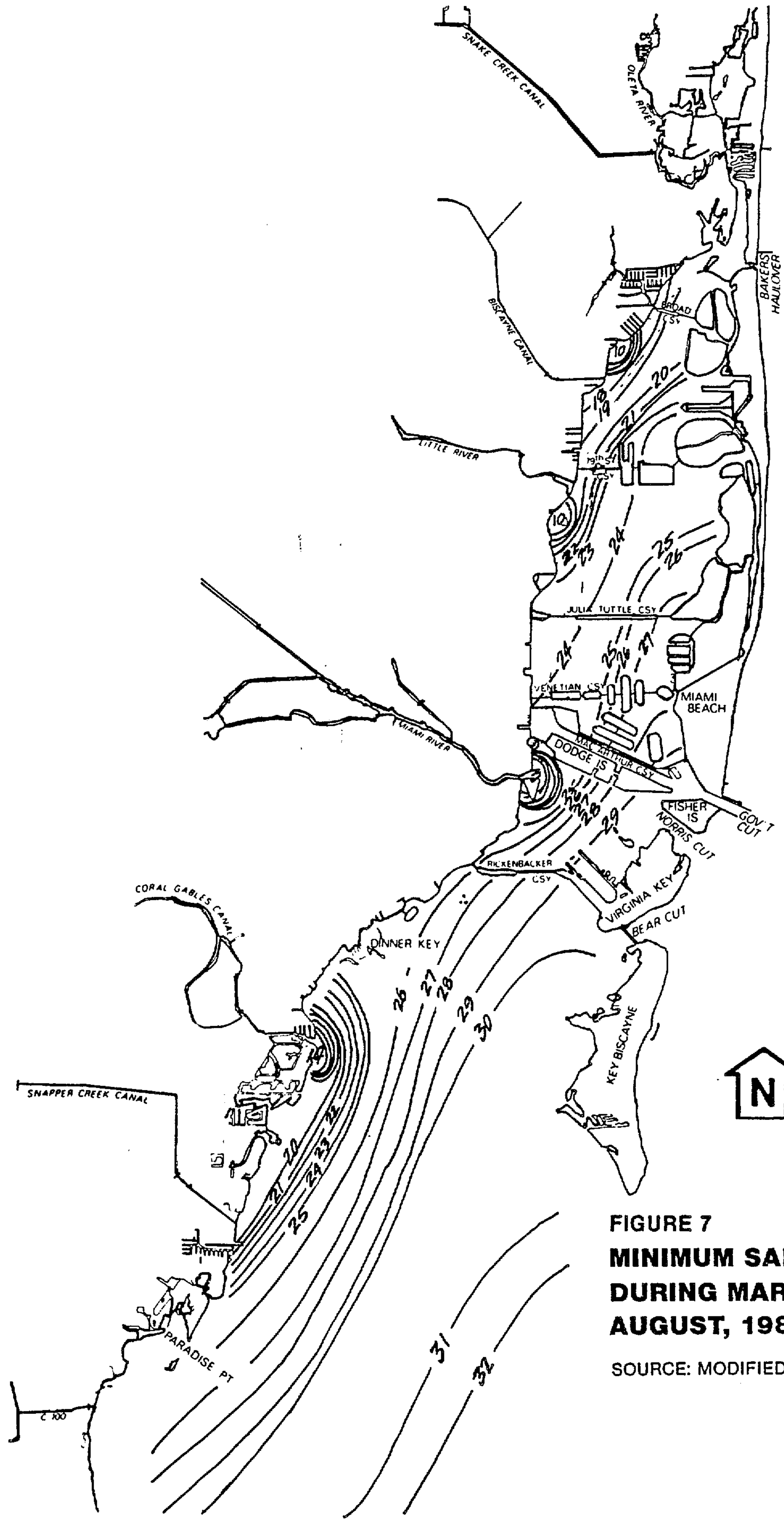


FIGURE 7
MINIMUM SALINITIES DURING MARCH, 1982-AUGUST, 1983

SOURCE: MODIFIED FROM WANLESS *ET AL*, 1984

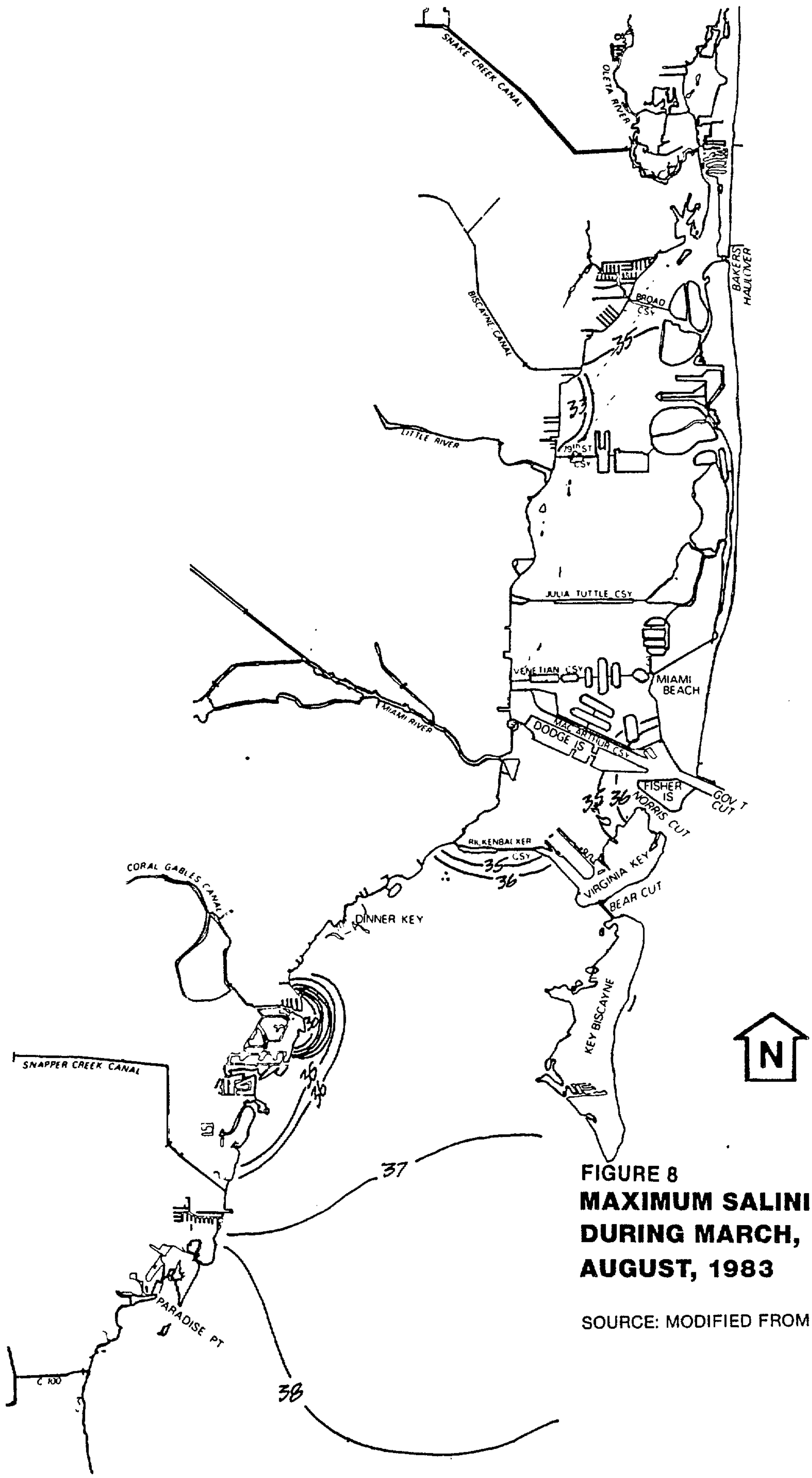


FIGURE 8
MAXIMUM SALINITIES DURING MARCH, 1982-AUGUST, 1983

SOURCE: MODIFIED FROM WANLESS _ET AL_, 1984 relatively calm center with surrounding counterclockwise winds. Those affecting Dade County develop in the Atlantic Ocean, the Gulf of Mexico, or the Caribbean Sea during the summer and fall months. The most severe local storms have occurred in September and October and developed in the eastern Atlantic (Gentry, 1974).

Throughout the century prior to 1974, south Florida was struck by more hurricanes than any other area of equal size in the United States. South Florida also had more great hurricanes per unit length of coastline than any other area of the country. During the period from 1886 to 1970, tropical storms occurred on the average of every five years, and hurricanes occurred every six years. Great hurricanes occurred on an average of once every 14 years (Gentry, 1974).

The influence of a storm is dependent on its forward speed and specific track (Wanless et al, 1984). Wind, lightning and storm surges associated with the Great Miami Hurricane of 1926 defoliated most of the taller mangroves on Key Biscayne and Virginia Key, but a little known hurricane in 1929 produced even more significant damage in those mangrove forests (Harlem, 1979).

In addition to the direct destruction of coastal forests, hurricanes and tropical storms caused severe erosion of barrier and spoil islands in the Bay. The 1926 hurricane eroded about 200 feet on both the north and south sides of Baker's Haulover Cut. Most of that sand flowed into the Bay and was deposited as a large fan-shaped delta (Harlem, 1979).

Hurricanes also damaged Bay bottom communities. The 1926 hurricane recontoured submerged plant communities in the area from Meloy Channel just north of MacArthur Causeway to a portion of the Safety Valve region at the southern end of Key Biscayne. Damage to the Safety Valve area was even more significant after the passage of the 1929 storm. Other damage to Bay bottom communities has been documented by Harlem (1979). One striking example is a large denuded area north of the Venetian Causeway that most likely resulted from the 1935 "Yankee Hurricane" (Harlem, 1979).

HUMAN HISTORY

Radiocarbon dating of archeological remains indicates that the permanent prehistoric settlement of the Biscayne Bay area date back to at least 2,000 B.C., and that there were inhabitants in this area as early as 8,000 B.C. in the Cutler Area (Carr, personnal communication, 1984). Despite a paucity of undisturbed coastal archeological sites, there are a number of facts that have been ascertained about these prehistoric settlers. There were many small camps dispersed along the Bayshore with a number of large settlements along various waterways, including the Miami River and Arch Creek, as well as on the barrier island known today as Miami Beach at Surfside (see Figure 9). These Tequesta Indians were a maritime 'canoe culture' and moved easily between the Bay and the Everglades through the natural waterways. The impact of these populations on the Bay was slight, and it is believed that there was a plentiful supply of food and resources (Carr, personal communication, 1984).

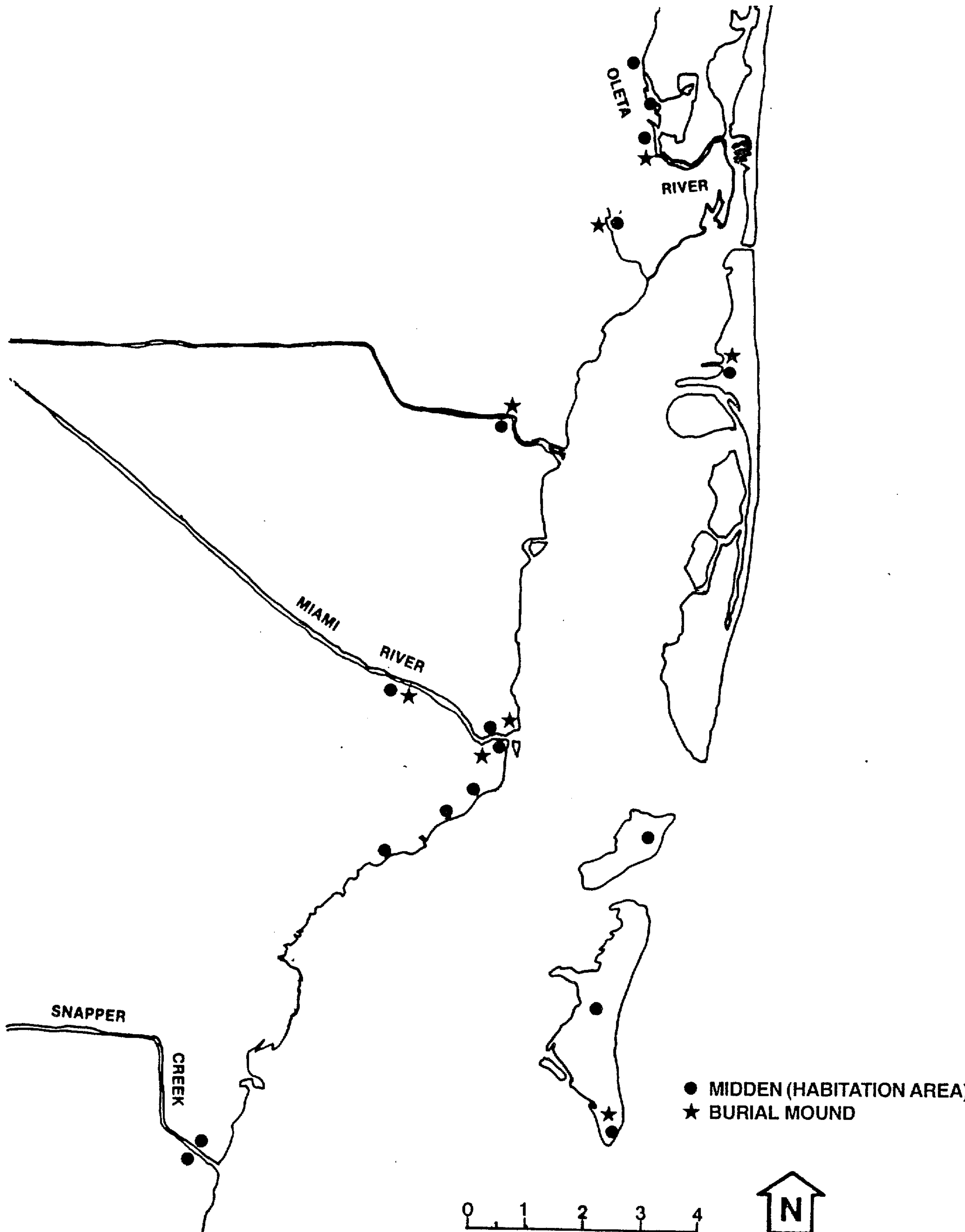


FIGURE 9
ARCHEOLOGICALLY SIGNIFICANT COASTAL PREHISTORIC SITES IN DADE COUNTY, FLORIDA

SOURCE: METRO-DADE COUNTY OFFICE OF COMMUNITY & ECONOMIC DEVELOPMENT, HISTORIC PRESERVATION DIVISION, 1982

From 500 A.D. to 1200 A.D., there was a dramatic increase of the Indian population (Carr, personal communication, 1984). The Indians were dispersed in seminomadic maritime settlements along the Bayshore, rivers and the Everglades. Their major settlement was the village called Tequesta by the Spaniards on the north side of the mouth of the Miami River.

Europeans made contact along the Bay from the 1500s to 1760 (Chardon, 1976); in 1513 Ponce de Leon discovered Cape Florida and sailed into Biscayne Bay (Redford, 1970). When the Spanish established their first settlement in 1567, a mission and a fort built on the periphery of the Indian's Village of Tequesta, the Tequesta Indian population along the Bay was at its maximum, of about 5,000 inhabitants (Carr, personal communication, 1984). Conflicts with the Indians resulted in the successive abandonment and resettlement of this area, and final abandonment by the Spanish in 1570 (Parks, personal communication). It was not until 1743 that the Spaniards tried to establish a second settlement. By that time, the Indian population was already declining due to disease, warfare and the exodus of the Tequestas to Cuba (Carr, personal communication, 1984).

With the beginning of British rule in 1763, the Bayside Indian population was totally gone (Chardon, 1976). For the next 40 years there were no settlements along the Bay, however, Bahamians came into the area to salvage wrecks on the reefs, to fish, and to hunt turtle. The Bahamians were also responsible for minimal alteration of the shoreline. Some hardwood hammocks along the mouth of the Miami River and some pine trees along the coastal ridge were cut (Parks, personal communication). Another alteration to the Bay area also included the introduction of foreign plant and animal species (Chardon, 1976).

In the early 1800s, white settlers and the Seminole Indians established settlements in the Bay area. Conflicts between the two groups led to frequent abandonment of the white settlers' homes. When Florida became a territory of the United States in 1821, the government set about to make some improvements. A lighthouse was built on Key Biscayne in 1825. Several military installations were established, including Fort Dallas on the Miami River and Fort Bankhead on Key Biscayne. These activities and the establishment of coontie mills resulted in minimal alterations to the river and Bay shoreline (Parks, personal communication, 1984).

Figure 10 shows a map that was redrawn from a sketch done in 1850 by a man stationed at Fort Dallas. The "hunting ground" and houses on the lower left were in the Cutler area, where the Deering Estate is located. This map shows that the only reliable access into the Bay was through the natural channel south of Key Biscayne. The Punch Bowl noted for its excellent water was located just north of Vizcaya. This limerock cave with its fine spring was mentioned in many early writings. In some it is called the Devil's Punch Bowl, but the reason for the ominous reference is unknown.

After 1870 there was an increase in the numbers and permanence of the white settlers. The population grew from about 100 permanent residents in 1876 (Chardon, 1976) to about 1,500 in 1896 when Henry Flagler's

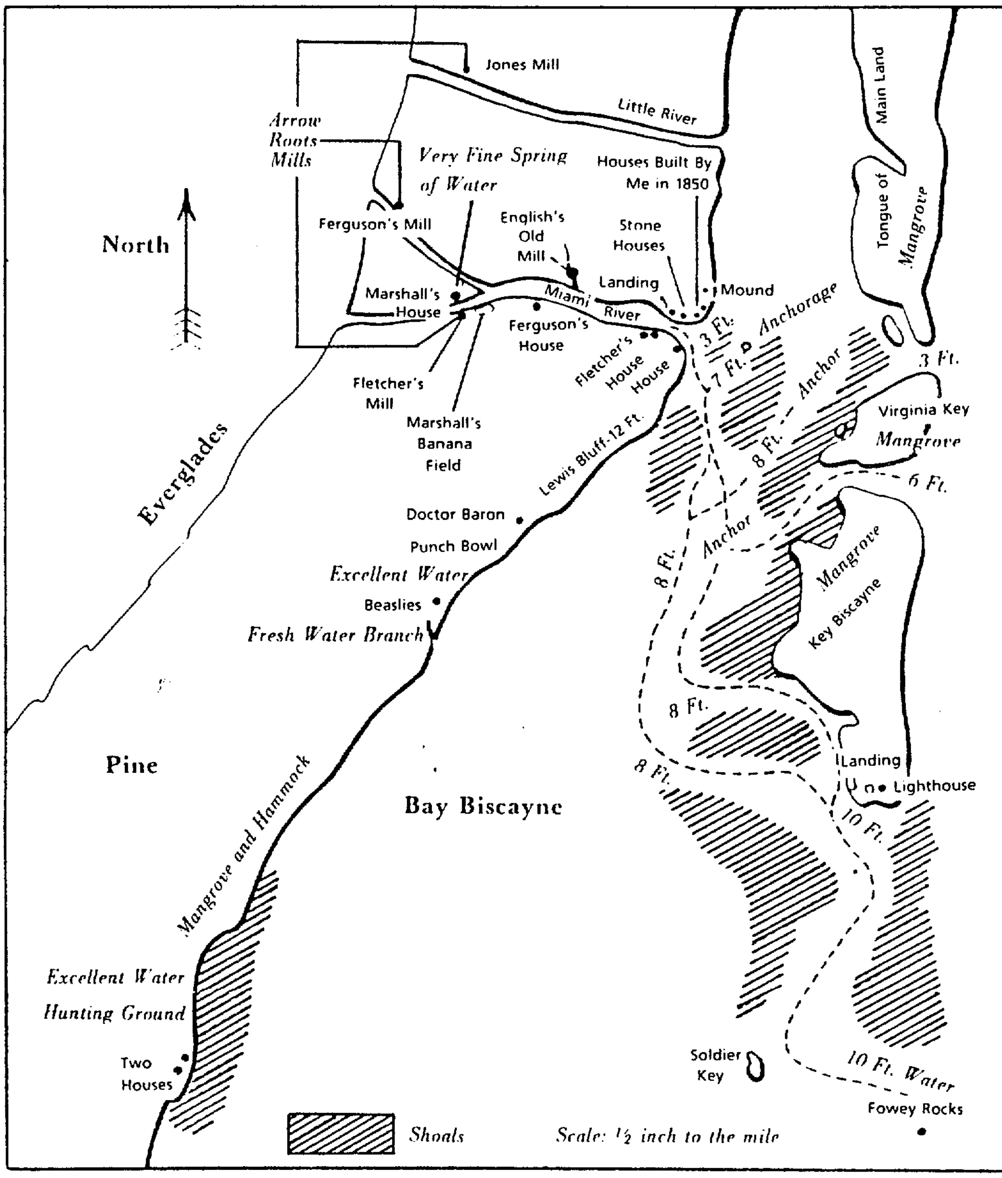


FIGURE 10

BISCAYNE BAY AREA 1850

SOURCE: KLEINBERG, 1985

Florida East Coast (FEC) Railroad arrived and the City of Miami was incorporated.

The arrival of Flagler's Florida East Coast (FEC) Railroad in 1896 marked the beginning of Miami's urbanization and laid the foundation for massive alterations of north Biscayne Bay's natural environment. The FEC Railroad Company dredged the Miami River, a basin just north of it and a connecting channel to the existing natural channel south of Cape Florida. Between 1896 and 1898 Miami River spoil was used to form the foundation of what is known today as Claughton Island or Brickell Key (Parks, 1984).

In 1900 local interests sought a better ship channel and in 1905 Government Cut was completed and opened through the narrow southern natural tip of Miami Beach. The dredge material from this project was deposited on Miami Beach's disconnected southern tip that later became known as Fisher Island (Chardon, 1976). Subsequently, jetties had to be constructed and then lengthened to keep the cut from filling with the sand that eroded off beaches to the north and south (Harlem, 1979). Because of constant shoaling, Government Cut was not useful as a shipping channel until 1925 (Harlem, 1979).

Meanwhile inland alterations of the natural landscape also affected the Bay. Major efforts to drain the Everglades were started in 1909. In that year the Miami River falls just west of the present 27 Avenue were destroyed (Parks, personal communication, 1984).

Before man's influence, Miami Beach consisted of a 200 foot wide sand spit covered with natural dune vegetation and an impenetrable mangrove forest, as much as one mile wide and 30 feet high, bordering the Bayshore (Redford, 1970). In the 1880s Henry B. Lum led an unsuccessful attempt to turn sixty-five miles of barrier island beaches from Jupiter Inlet to the southern tip of Key Biscayne into a coconut plantation. By 1890 this operation was abandoned (Redford, 1970). Originally attracted to this area in 1896 to see where his $5000 investment in Lum's coconut plantation had gone, in 1907 John S. Collins purchased a five mile long strip of Miami Beach from the Bayside to the oceanside, between the current 14th and 67th Streets. In 1912 Collins began construction of the Collins Canal, and the Collins Bridge, the first bridge across Biscayne Bay. The dredged material taken from the canal, which connected Lake Pancoast at the southern end of Indian Creek to the Bay, was used to fill a mangrove swamp and create Belle Isle (Peters, personal communication, 1984).

In 1913 Carl Fisher began construction of what is known today as Miami Beach. The mangrove forests were cut and the marshes and swamps filled with a thick layer of seagrass covered, organism-filled bottom material dredged from the Bay (Redford, 1970). The once shallow Bay waters became a deep and turbid water body with smoothly bulkheaded shores (Redford, 1970). In 1925 Indian Creek was deepened and Meloy Channel was dredged. The fill was used to create adjacent land on Miami Beach (Wanless et al, 1984).

Massive environmental changes did not end with the filling and creation of the new Miami Beach. Construction of the County (now MacArthur) Causeway was begun in 1916, but the Causeway was not opened until

January 1, 1920. Constructed with fill from the dredging of the Miami Ship Channel and Turning Basin, the County Causeway hindered water circulation to such an extent that north Bay became stagnant. It was not until Baker's Haulover Cut was opened in 1925 that water flow into, and circulation within north Bay was improved. The input of ocean water created dramatic changes in the salinity regimes, circulation patterns and the bottom communities of north Biscayne Bay (Wanless et al, 1984).

Star Island, the first totally artificial island in the Bay, was created between 1917 and 1918 by Carl Fisher and his business partners. This island was connected to the County Causeway, and provided inspiration for others to create saleable real estate in the Bay. As a result, islands began popping up between the mainland and Miami Beach.

In 1919 the Flagler monument was constructed on a spoil island created between Star Island and Miami Beach. In 1924 the Venetian Causeway was constructed replacing the wooden Collins Avenue Bridge. By 1925 Palm and Hibiscus Islands joined Star Island along the County Causeway, and Belle, DiLido, Rivo-Alto, San Marco and San Marino islands were created along the Venetian Causeway. Pilings for Pelican Island, the next island in this chain that was never completed, can be seen just south of the Julia Tuttle Causeway. Had it not been for the great 1926 Hurricane and the stock market crash in 1929, "Venetian Isle" construction might have continued up the middle of north Bay (Redford, 1970).

Major alterations continued after the boom time of the early 1920s. In 1927 the 79th Street Causeway was started and the Miami Ship Channel was again deepened and widened. By 1929 the Intracoastal Waterway was completed, leaving behind about 15 spoil islands on the western side of the Bay. By 1933, the Miami River had also been dredged to its present depth of 15 feet.

The Federal War Department established a bulkhead line along the mainland shoreline that defined the extent to which shoreline properties could be bulkheaded and filled. In central Bay this line was located hundreds of feet offshore. Commodore Ralph Munroe, a longtime Coconut Grove resident spoke eloquently about the environmental, health and safety impacts of dredging, filling and bulkheading the shallow Bay. In spite of his arguments, some Bayfront residents took advantage of the line and increased the size of their property (Munroe and Gilpin, 1974).

Although the State of Florida claimed title to all submerged lands in the Bay, the islands between the mainland and Miami Beach, were striking examples of how saleable, profitable land could be created in the Bay. In the 1920s, a group of men claiming to have millions of dollars and political influence unveiled plans to create a string of artificial islands from Coconut Grove south to Cocoplum. They would have been connected to the mainland by three drawbridges, and would have blocked views of the Bay for existing Bayshore residents (Munroe and Gilpin, 1974). Commodore Munroe voiced his and the community's objections, and with the end of the boom times in Miami, this plan never reached fruition (Munroe and Gilpin, 1974).

Development across and along the Bay continued through the next few decades. Rickenbacker Causeway was started in 1941 and completed in 1947. In 1950 the southern mangrove tip of Key Biscayne was bulkheaded and filled (Harlem, 1979). In October 1951 the Broad Causeway at 125 Street was completed. The Julia Tuttle Causeway was finished in 1960 and opened to traffic in 1962.

The Port of Miami was created in the 1960s over Dodge Island and three smaller spoil islands that had been formed as a result of the multiple dredgings of the shipping channel between 1905 and 1960. By 1983, the Port completed its expansion from Dodge to Lummus and Sams Islands. In the 1960s, Claughton Island (Brickell Key) and Fair (Grove) Isle were expanded (Wanless et al, 1984). Since 1980 development within Biscayne Bay has mostly been restricted to bulkhead and dock replacement or repair, the placement or repair of pilings, maintenance dredging, placement of utility and water lines, the establishment and expansion of marinas, and the expansion of the Port of Miami.

In summary, since 1890, over 20 percent of the natural water area of north Biscayne Bay has been filled to create almost 30 islands and six causeways; another 20 percent has been dredged into waterways, borrow pits and channels (Chardon, 1976). In response to Miami's early priorities of tourism, land development and commerce, these alterations doubled the amount of linear shoreline (Harlem, 1979).

PART II

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC PRESERVE MANAGEMENT AREA

CIRCULATION

The main force behind flow in and out of Biscayne Bay is the astronomic tide. Tidal flow enters north Biscayne Bay through Baker's Haulover and Government and Norris cuts. In central Bay tidal flow enters through Bear Cut, the channel south of Key Biscayne, and across the Safety Valve network of channels and shoals.

Tides in the Bay are semi-diurnal (twice daily) and the amplitude ranges from about 2 feet in north and central Bay, to one foot in the Bay south of the APMA. The Bay tidal ranges are about 80 percent of the Ocean's tidal range (van de Kreeke and Wang, 1984).

NORTH BAY

Tidal circulation in north Biscayne Bay depends primarily upon the openings in the causeways. The largest openings are in the MacArthur Causeway. As one proceeds north, the openings generally decrease to the point where the openings in the Broad Causeway are less than half as large as those in the MacArthur Causeway (Van de Kreeke and Wang, 1984).

Tidal currents are greatest at the Ocean inlets and at bridge or causeway openings. In the open areas of north Bay, tidal currents are relatively small, however, there are very few areas where there are stagnant conditions. This is due, in part, to the fact that the generally rectangularly shaped basins (Units II-VI) are connected to one another at their "corners."

Because of the relatively short lag time in the tide between the major openings into north Biscayne Bay, and to a lesser extent because of inlet and general Bay configurations, there is a net southerly flow within north Bay and very little east to west flow. This east/west separation is confirmed by observed salinity patterns (see Figure 7).

Tides flowing in through Baker's Haulover Cut meet tides coming into the Bay through Government Cut in the middle of Unit II, midway between the Broad and 79th Street causeways. At that point, called the tidal nodal point, tidal currents are extremely small. The flow velocities generally increase with increasing distances from the nodal point (Van de Kreeke and Wang, 1984).

In February 1983 funnel shaped wooden floats, called drogues, were used to determine water movement in Units III and IV. In Unit III, current speeds varied from five to 15 centimeters per second in a generally southerly direction (see Figure 11). In Unit IV, the tidal flows were more complex, but a generally north/south flow pattern was observed (see Figures 12 and 13).

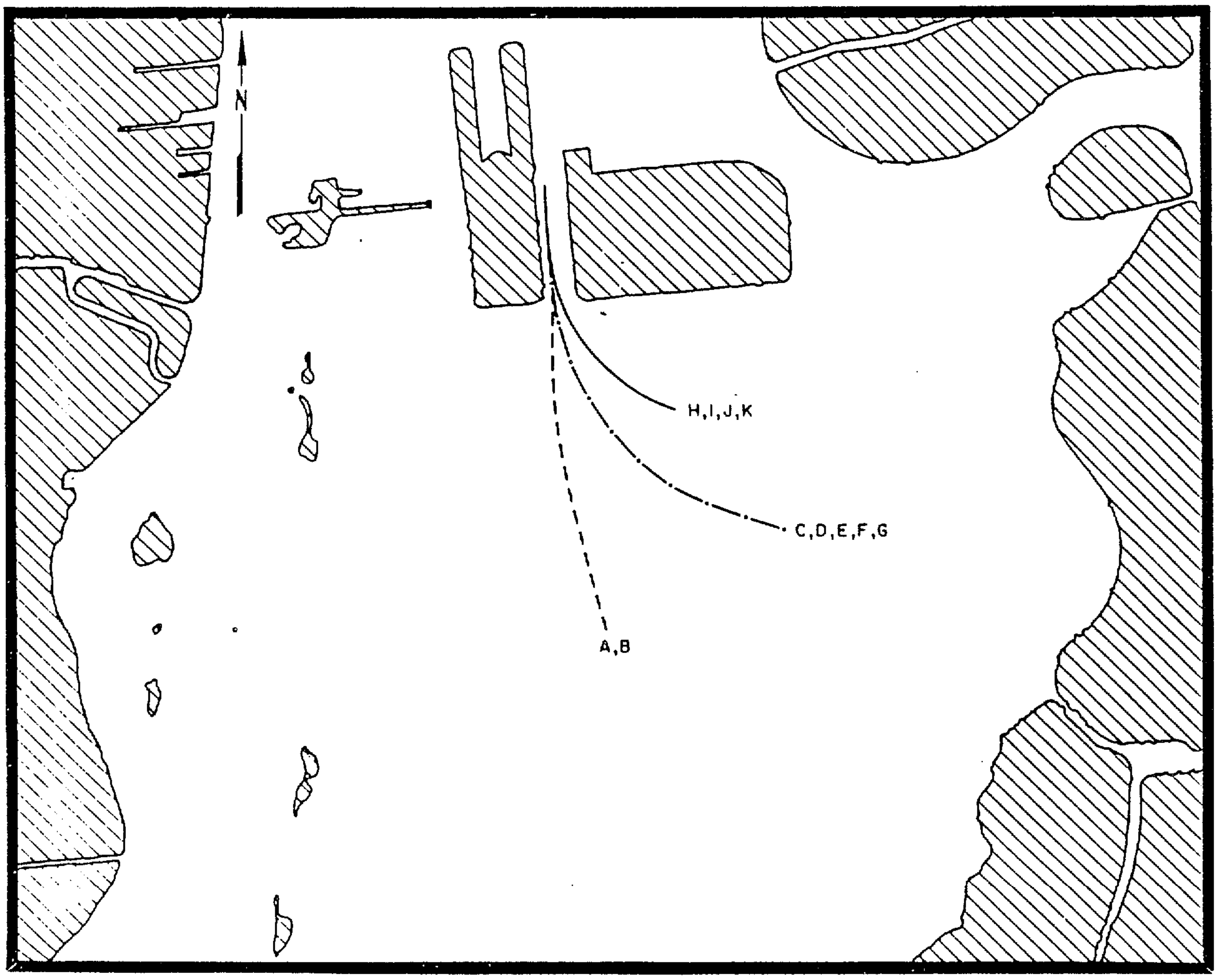


FIGURE 11

DROGUE FLOAT PATHS-UNIT III

SOURCE: van de KREEKE & WANG, 1984

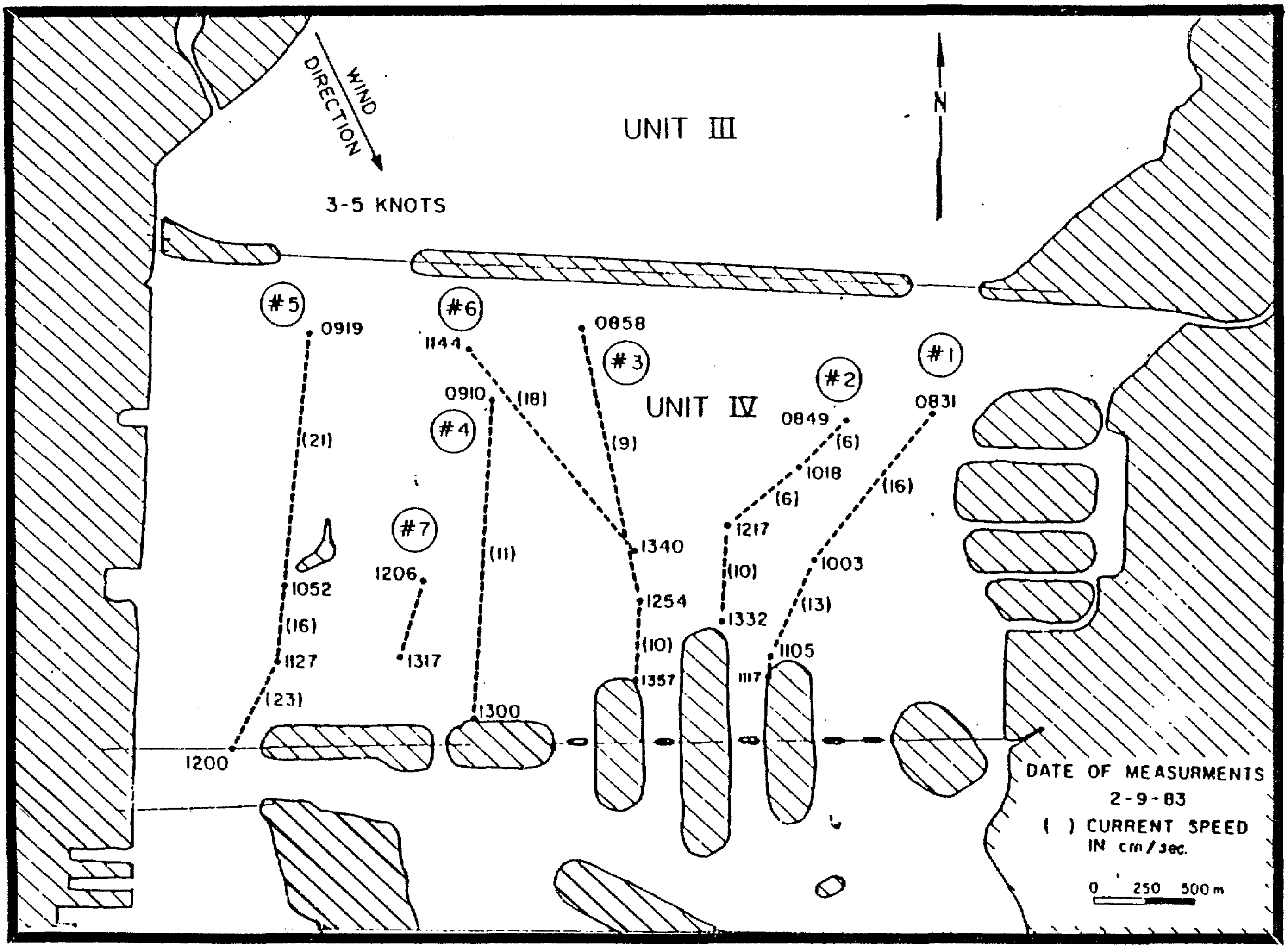


FIGURE 12

DROGUE FLOAT PATHS-UNIT IV-EBB TIDE

SOURCE: van de KREEKE & WANG, 1984

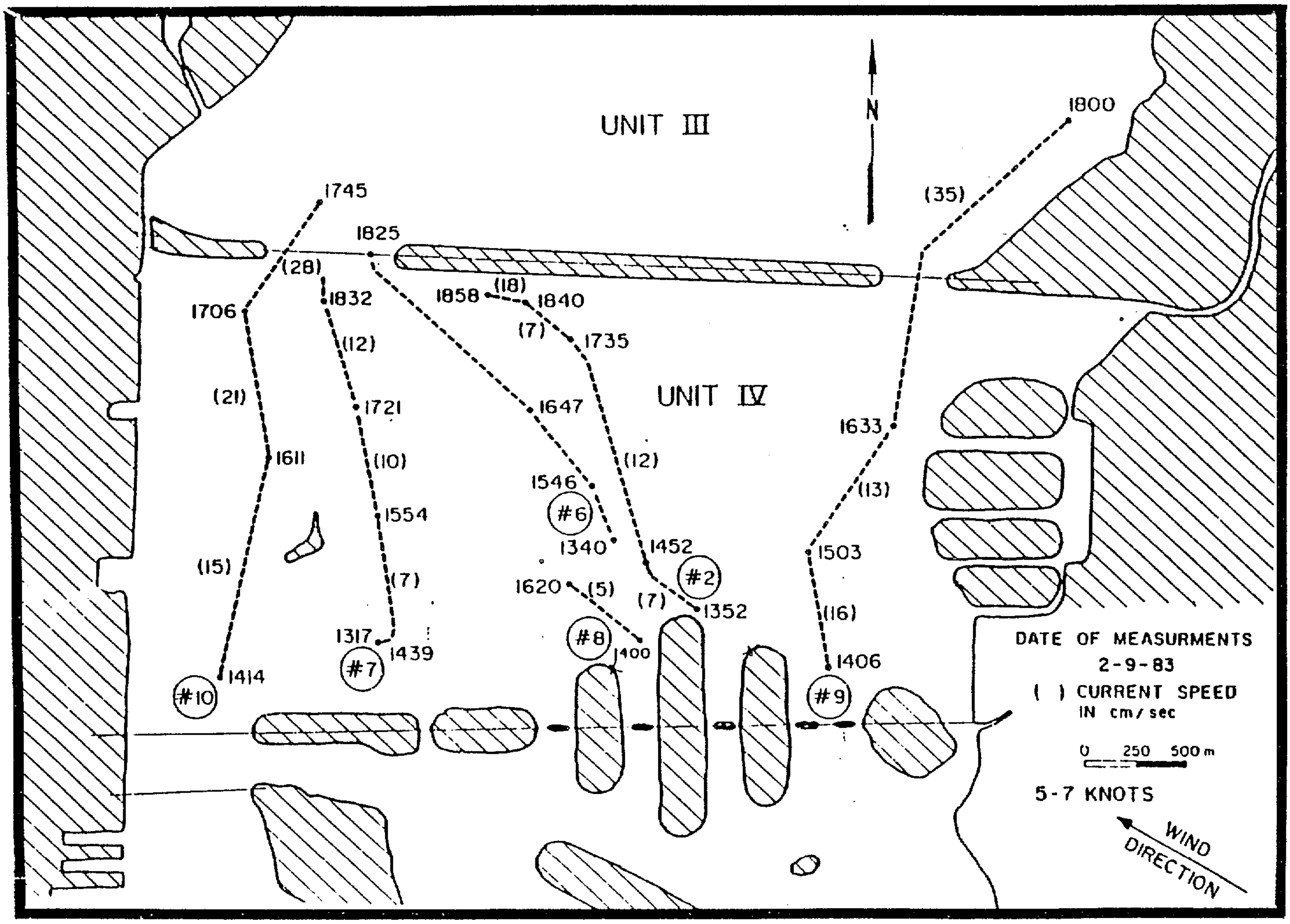


FIGURE 13

DROGUE FLOAT PATHS-UNIT IV-FLOOD TIDE

SOURCE: van de KREEKE & WANG, 1984

In addition to recorded drogue movements, computer models were used to determine how long it takes water to flow through the north Bay area. Using computer simulation, imaginary water particles were placed at the northern end of Unit I and in the middle of Units II, III, and IV. Models were then used to predict the residence time of the water particles in each unit; that is the time that would be required for a particle to leave the unit where it was originally placed. Calculations were made using tidal flows only, as well as tidal flows with winds from the north or south. Units with larger widths had longer residence times (see Table 1).

Residence time estimates vary from a low of less than one day in Units I, V, and VI, up to a high of one week in Unit III (Wang and van de Kreeke, 1984). In north Bay a consistent north wind decreases overall residence time by the order of up to 2 days, and a consistent south wind increases overall residence times by the order of up to 7 days (Wang and van de Kreeke, 1984).

TABLE 1

Estimated Unit Residence Times of Water Particles in North Biscayne Bay (in days)

	Unit I	Unit II	Unit III	Unit IV	Units V & VI	Unit VII
Tide only	0.5	5	7	3.5	-1.0	1.0
South wind 4.5 m/s	0.5	6.5	14	5	-	-
North wind 4.5 m/s	0.5	3.5	7	2	-	-

Source: Modified from Wang and van de Kreeke, 1984.

Dredging of the Port of Miami channels has changed the tidal flow patterns in the Government Cut area. The deepening of the South Channel between Fisher Island and the Port has greatly increased tidal flow into and out of Unit VII, however, the flow through Norris Cut has decreased (van de Kreeke and Wang, 1984).

Unlike Units II-IV where tidal currents flow in a north to south direction through channels cut at the "corners" of the units, water flows into and through Unit VII from several locations and directions. On ebb tide water flows north through the relatively constricted openings in the Rickenbacker Causeway. For this reason van de Kreeke and Wang (1984) consider this Unit to be part of central Bay from a hydrological perspective.

CENTRAL BAY

Circulation in the Central Preserve Management Area (CPMA) is directly influenced by the tidal flow through Bear Cut and across the Safety Valve, and the connection with north Bay through the Rickenbacker Causeway. More water enters the CPMA across the Safety Valve during an incoming tide than leaves on an outgoing tide. Net water movement in the CPMA is in a northerly direction through the Rickenbacker Causeway (Swakon and Wang, 1977). However, currents in the CPMA exhibit a reversing pattern which is strongly influenced by tidal fluctuations (Swakon, personal communication). During both neap tides when there is less than usual difference between low and high tides, and spring tides when there are unusually high and unusually low tides, the current reverses and water flow turns towards the south (Swakon, 1977).

As in north Bay, current velocities are weaker in the interior portions of the CPMA (5-30 centimeters per second) than near the Ocean inlets (30-60 centimeters per second). Another important factor influencing water circulation in the CPMA is wind, which can cut the residence time in half (Swakon, personal communication).

TOPOGRAPHY

Biscayne Bay is underlain by a shallow bedrock basin of Pleistocene limestone; with Miami oolitic limestone forming the Atlantic Coastal Ridge defining the western shore, and Key Largo limestone on the eastern ridge (Harlem, 1979).

> "The limestone topography within Biscayne Bay changes from south to north. In southern Biscayne Bay, the limestone surface very gently slopes to the east to a deep axis over 3/4 of the way across the bay. Superimposed on this slope are two NNE trending promontories. One extends from the Turkey Point area; the other occurs off the Cutler area in association with Black Ledge. The axis of the Bay deepens from only 3m at the south end northward to over 6m in the vicinity of Key Biscayne.
>
> To the north, the mainland limestone surface slopes more and more steeply into the bay, and in the area near Viscaya (north of Coconut Grove) the limestone drops to over 5m below sea level within a few hundred meters of the shoreline. The limestone is deep and irregular across the Bay in this area.
>
> From the Miami River to the north end of Biscayne Bay, the mainland ridge drops quite sharply into the Bay but there is again a gentle eastward slope to the surface. The limestone floor to the Bay is only about 2m in depth at the north and where the mainland and seaward ridges have nearly converged. The bedrock axis of northern Bay deepens to the south to the vicinity of Key Biscayne." (Wanless et al, 1984, p.8.)

DEPTH

Biscayne Bay averages six feet in depth and is generally less than 10 feet deep, except where the bottom has been dredged (Harlem, 1979). Nine and one-half square miles in central Bay have been dredged and thirteen square miles, or 49 percent of north Biscayne Bay has been dredged to depths ranging from 10 to 16 feet. The borrow pit north of the Julia Tuttle Causeway and the Government Cut Channel have been dredged to more than 29 and 39 feet, respectively (see Figures 14 and 15).

SEDIMENT

During the last 6,000 years the shallow limestone basin which forms Biscayne Bay filled with sands, skeletal and silica fragments, muds derived from the limestone bedrock and carbonate materials and organic matter of varying depths. These sediments are generally thickest over the limestone near the barrier island chain decreasing to a thin veneer over the bedrock on the southern and central portions of the Bay (Harlem, 1979).

SEDIMENT SOURCES

There are several sources of sediment in Biscayne Bay including quartz sand, calcium carbonate skeletal fragments, silica particles and limerock and organic matter. Quartz sand is derived from Ocean beaches, the Atlantic Coastal Ridge adjacent to northwestern Biscayne Bay on the mainland, and material deposited along western Bay shoreline north of Coral Gables Waterway during the Holocene rise in sea level. Calcium carbonate skeletal fragments range from cobblestone-sized corals and mollusks to tiny needles derived from the "skeleton" of calcareous algae. Silica particles are produced by sponges and diatoms which are tiny unicellular or colonial algae. These particles may be dissolved in the alkaline conditions of marine deposits. Thus, they are not nearly so abundantly represented in the sediments of Biscayne Bay as they are in suspensions.

The limestone bedrock contributes to Bay sediments in two ways. First, erosion of hard bottom areas and rocky shorelines produces fine sands and muds. Secondly, areas of dredged limestone fill provide calcium carbonate particles in sizes ranging from gravel to mud.

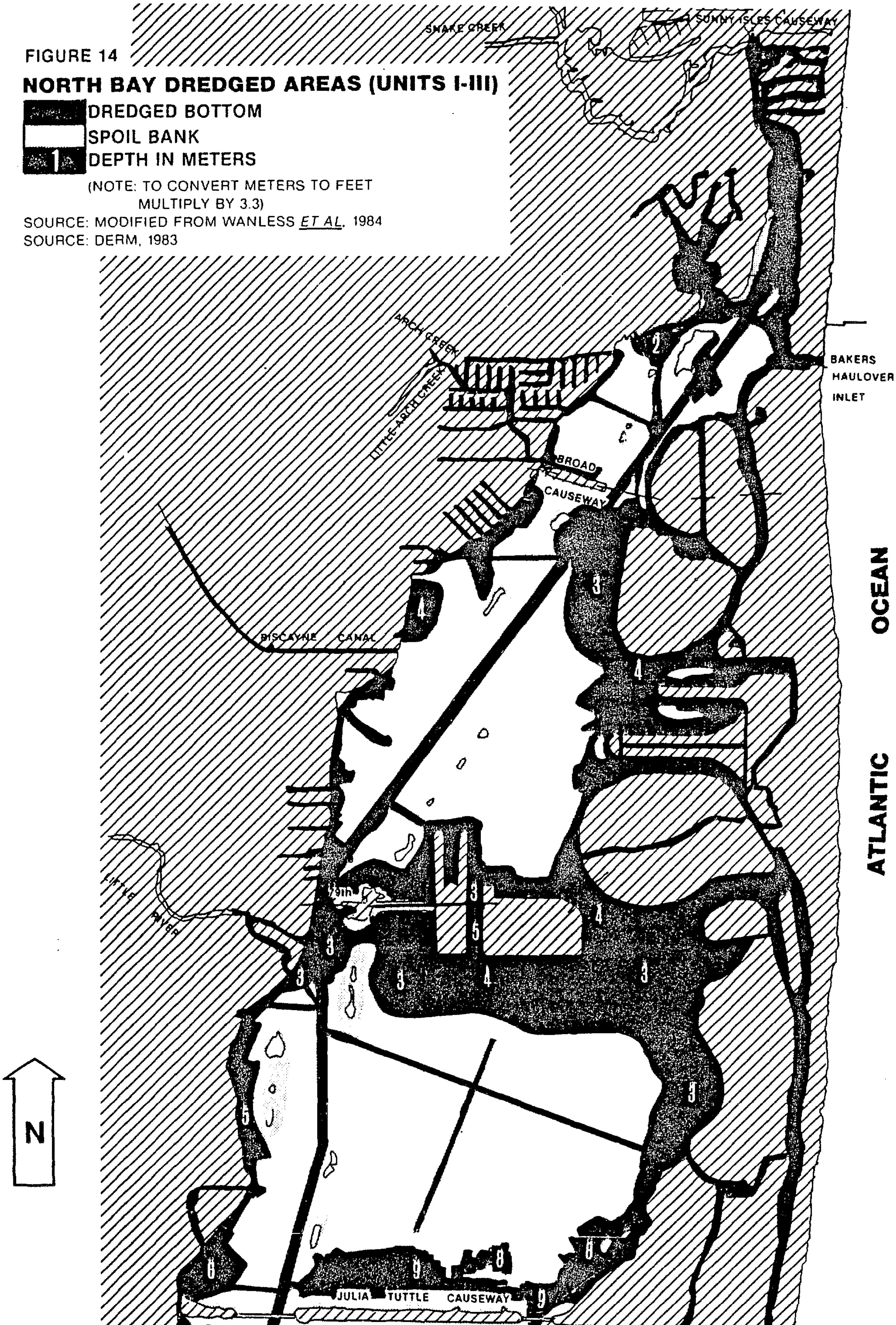
Organic matter is produced in the Bay both in the water column and at the sediment surface, reworked from older, natural or man-made sediment bodies and washed into the Bay from upland areas. Most organic matter is sufficiently degraded that identification of origin is not possible, except for living or partly decomposed roots and blades of seagrasses and algal filaments.

SEDIMENTARY REGIMES

During the past few thousand years the sand, mud, carbonate and organic sediments in the Bay were worked and reworked by the forces of nature into four general sedimentary regimes: rocky areas, sandy areas, muddy areas, and carbonate muds. Within these four categories, plus spoil

FIGURE 14

NORTH BAY DREDGED AREAS (UNITS I-III)



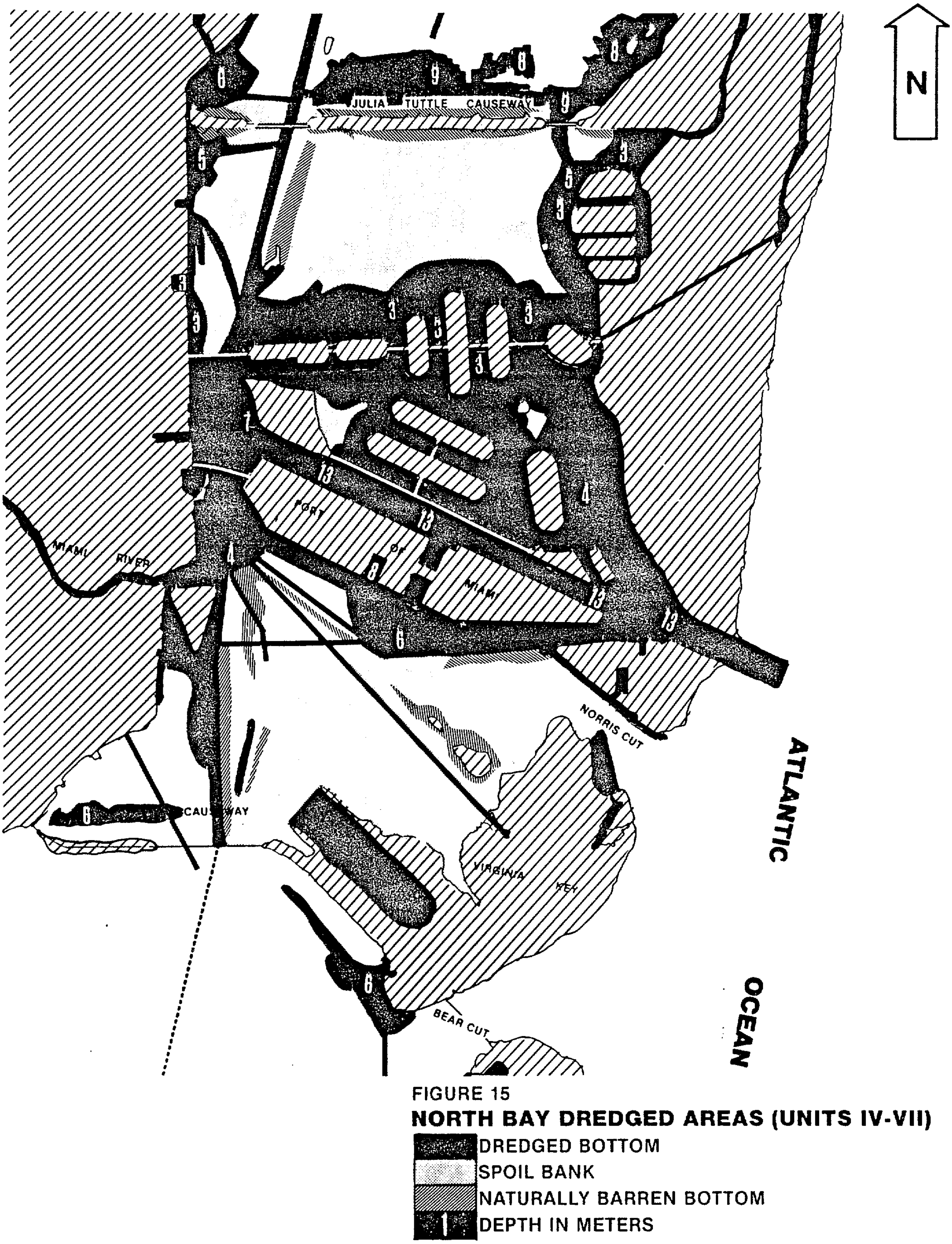


FIGURE 15
NORTH BAY DREDGED AREAS (UNITS IV-VII)

(NOTE: TO CONVERT METERS TO FEET MULTIPLY BY 3.3)
SOURCE: MODIFIED FROM WANLESS *ET AL.* 1984
SOURCE: DERM, 1983

margins and mangrove areas, Wanless (1984) identifies ten sedimentary environments in and adjacent to Biscayne Bay. The following discussion is paraphrased from Wanless (1984).

Rocky Bottom Areas

Much of the central Biscayne Bay basin is either exposed limestone or has less than 6 inches of sediment cover over limestone (Figure 16). These areas are characterized as being producers of sediment and serving as day-to-day sediment trappers and filters, but not as long term sediment sinks, or areas where long term deposits of sediment are found. Quite large volumes of fine carbonate and siliceous particles are produced by rocky bottom communities. Storms sweep this material into adjacent marine environments, offshore, or into coastal mangrove swamps.

Rocky bottom areas have only a thin veneer of sand over rock for three reasons. First, frequent minor storms agitate the bottom so that winnowing occurs and finer sediment is moved away. Second, there is a sufficiently low rate of sediment influx or local sediment production so that winter storms combined with sporadic hurricanes, can remove most of the sediment produced. Third, seagrasses cannot develop an effective stabilizing cover in these areas to effectively survive storm events.

Since the last hurricane struck the Dade County area in 1966, these rocky bottom areas have been covered to an unusually large extent by seagrasses. Wanless (1984) states that these seagrasses are expected to be largely destroyed by any major storms or hurricanes, and that the seagrasses that do survive will most likely be those associated with local depressions in bedrock where thicker sediment accumulations occur.

During the conditions of winds and storms that generally prevail in the Bay area, water tends to be very clear above rocky bottom environments that are inhabited by hard bottom communities of sponges, molluscs corals, and soft corals. These organisms actively filter and trap suspended particles as part of their breathing and feeding processes. It should be noted that only about 2 square miles of hard bottom community exists within the APMA, but extensive areas of hard bottom communities exist on central and eastern south Bay in Biscayne National Park.

Dredged Rocky Bottoms. Thirty-three percent of the APMA has been dredged to between 10 and 16 feet. In these areas light penetration is not sufficient to promote growth of either seagrasses or algae mats. If sufficiently deep and isolated from circulation and wave energy, dredged areas may serve as true sediment sinks, trapping sediments. However, most of the dredged areas of the Bay are not isolated. These areas become reservoirs for repetitive resuspension of fine grained materials that are reworked by organisms into fluffy (flocculated) masses. Tides, wind, waves and boat wakes easily stir the flocculated sediments, creating a turbid condition in the water column.

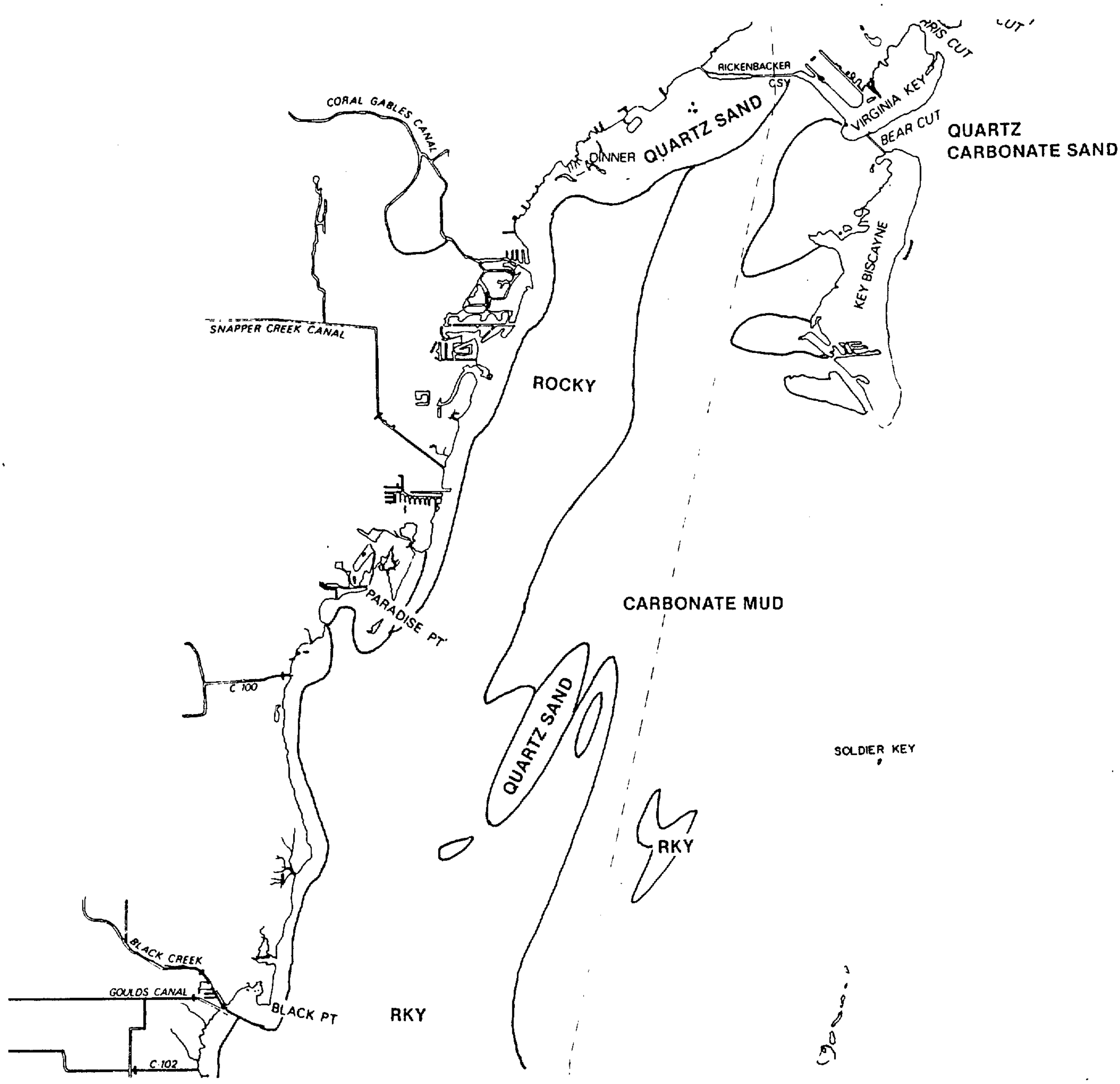


FIGURE 16

SURFACE SEDIMENTARY ENVIRONMENTS

NOTE: DOES NOT INCLUDE DREDGE &
FILL MODIFICATIONS

SOURCE: WANLESS _ET AL_, 1984

Sandy Bottom Areas

There are three types of natural sandy bottoms in Biscayne Bay: quartz sands, barrier island quartz-carbonate sands, and skeletal carbonate sands. Even if seagrass covered, sandy substrates exist because prevailing or winter storm processes are sufficient to remove fine sediments. A sandy area that has a good seagrass cover will tend to be finer grained, have a bit more mud and have a more stable community of animals dwelling within the sediments than an adjacent barren sandy area.

Mud may also be carried down into a sandy substrate by burrowing organisms. Most of the mud that accumulates will be released during storms or during erosional periods.

Quartz Sands. These sands cover the western portion of Biscayne Bay and become increasingly important north of Coconut Grove. This sand is mostly quartz with molluscan fragments and grains of shells from tiny animals known as foraminifera. In areas that are frequently agitated, such as Black Ledge, the sand is clean and rippled. In more protected areas, organic detritus and carbonate muds increase in abundance, but the organic matter rarely exceeds five percent. Along the near shore from Matheson Hammock south, the quartz sand forms a thin veneer over mangrove peat.

Depending upon salinity and water depths, significant portions of the quartz sand bottom areas are covered with patchy to occasionally dense seagrass communities that trap and filter suspended particles from the water column. The water is generally moderately clear where there are significant areas of seagrass cover. The Bay-ward edges of the quartz sand bottoms north of Matheson Hammock are generally too deep for seagrass growth. These gently sloping flanks are significant sites of sediment resuspension during onshore winds. Also, salinity fluctuations along the mainland portion of the Bay prevent turtle grass, Thalassia, from being the dominant seagrass. The shoal grass that frequently vegetates this area is less effective than turtle grass at trapping and filtering suspended particles from the water column.

Barrier Island Sand. This is a quartz-carbonate sand swept southward from the ocean beaches by long-shore ocean currents. These sands form flood tidal deltas adjacent to present and former inlets in Biscayne Bay. Barrier Island sands occur adjacent to Baker's Haulover Cut, the former Boca Ratones Inlet (near 79th Street Causeway), Norris Cut, Bear Cut and at West Point on Key Biscayne. At Boca Ratones and West Point, the inlets are now sealed and a significant amount of mud is mixed with the sands.

A sand delta formed at Baker's Haulover after the inlet was cut in 1925. This area of highly mobile sand has been repeatedly dredged to maintain navigable depths through the inlet and in the Intracoastal Waterway.

The sands associated with the Norris Cut inlet have partly been swept into the artificial channel adjacent to Fisher Island, and deposited on the shallow platform on the northwest edge of Virginia Key. The shallow portion of the area is covered with mobile sand, while the deeper area is somewhat stabilized by seagrasses. Fine grained sediments carried into either Norris Cut or Baker's Haulover tend to be swept across those deltas and into the Bay.

Aerial photographs show that the tidal delta of Bear Cut was extensively colonized by seagrass in 1940. Dredging to the northwest and the continued loss of sediment offshore has caused this delta to be eroded. Consequently, the area of seagrass cover has been reduced. However, on incoming tides particles suspended in the water column settle within some of the lobes between channels and on the Bay-ward flank of the delta. As these areas are re-stabilized by seagrasses, this delta is again becoming a significant trap preventing fine sediment from moving into the Bay.

Skeletal Carbonate Sands. These sands dominate the margins of tidal channels in the Safety Valve and along the narrow eastern portions of Featherbed Banks. These are composed of locally produced skeletal grains of calcareous algae, corals, coralline algae and mollusks and will not be discussed in detail as they are mostly outside the APMA.

Muddy Bottoms

Carbonate and sandy muds dominate the bottom in the middle to eastern portions of north and central Biscayne Bay within the APMA and central and southern Biscayne Bay and Cutter Bank, outside of the Preserve. Within the APMA an extremely important bank of carbonate mud covered by seagrass and calcareous algae is found in Unit III north of the Julia Tuttle Causeway. The crest of this bank is less than 3 feet deep. Though now surrounded by steep dredged troughs and waterways on all sides, this bank supports a lush seagrass and calcareous algae cover that effectively baffles, traps, and filters particles from the water column, making this one of the clearest spots in the Bay.

Barren Mud Bottoms. In Biscayne Bay barren mud dominates the bottom of dredged depressions and naturally deep areas that are poorly flushed and receive insufficient light to support benthic or bottom vegetative communities. Some of these areas have a fairly firm mud substrate. More commonly, however, there is a flocculant, very turbid zone that extends from four to as much as 24 inches above the bottom. In part, this is produced by organisms dwelling within the sediments. This turbid water is somewhat denser than the water above and flows down slope if there is any gradient to the bottom. This turbid layer can also be easily dis-bursed through the water column into adjacent areas by any gentle tidal or wave turbulence.

Carbonate Muds

In many areas of northern Biscayne Bay there are concentrations of coarse molluscan material at the surface or beneath a layer of mud. Where these occur at the surface they are an indication of persistent ongoing erosion. In each case they are a record of an earlier time of shell concentration presumably created by major storms, followed by a time of mud accumulation or benthic community growth. The presence of abundant shell layers on the flank of the bank and extending out under the soft mud in the bank north of Julia Tuttle Causeway is considered good evidence that the flanks are actively eroding and that the mud is an ephemeral deposit that will be resuspended during major storms.

Spoil Margins

Unbulkheaded spoil banks and islands have been produced by dredging sands, muds, and limestone from the Bay bottom. The resultant spoil is a mixture of mud, sand, shell, and gravel.

Spoil margins on islands and causeways and unconsolidated shoreline banks are eroded both by storm waves and currents and by boat wakes. In the process quite large lobes of sand spread across adjacent Bay bottom environments. As the sand and mud are washed out, the banks become armored or hardened with coarser material which slows erosion. However, large storms wash away the coarse armor. As a result, spoil margins tend to be a persistent source of fine sediment release during heavy winds. Figures 14, 15 and 17 show the spoil areas and Figures 18-20 show the unconsolidated shorelines in the APMA.

Mangrove Swamps

Fine grained quartz sand has been concentrated by the coastal mangrove swamps for thousands of years. As the sea level gradually rose, storms eroded the mangrove shoreline and swept sediment into the mangrove swamps. The acidic peat substrate associated with the red mangroves dissolved the calcium carbonate grains, leaving pure quartz sand mixed with the mangrove peat. As the peat became exposed and eroded at the shoreline, it is oxidized leaving behind quite pure quartz sand. On re-exposure at the shore some of this fine sand is moved offshore into the open Bay.

Mangrove forests also contribute fine organic material (detritus) to the Bay system. This has been well documented as a source of food for many of the small animals that dwell within the water column and within bottom communities.

WATER AND SEDIMENT QUALITY

Water and sediment quality in the APMA is affected by the flux of chemicals and particles from canals, surface and ground water seepage, storm drain discharges, rainfall and ocean tides. All except rainfall and tides are influenced directly or indirectly by upland water management practices.

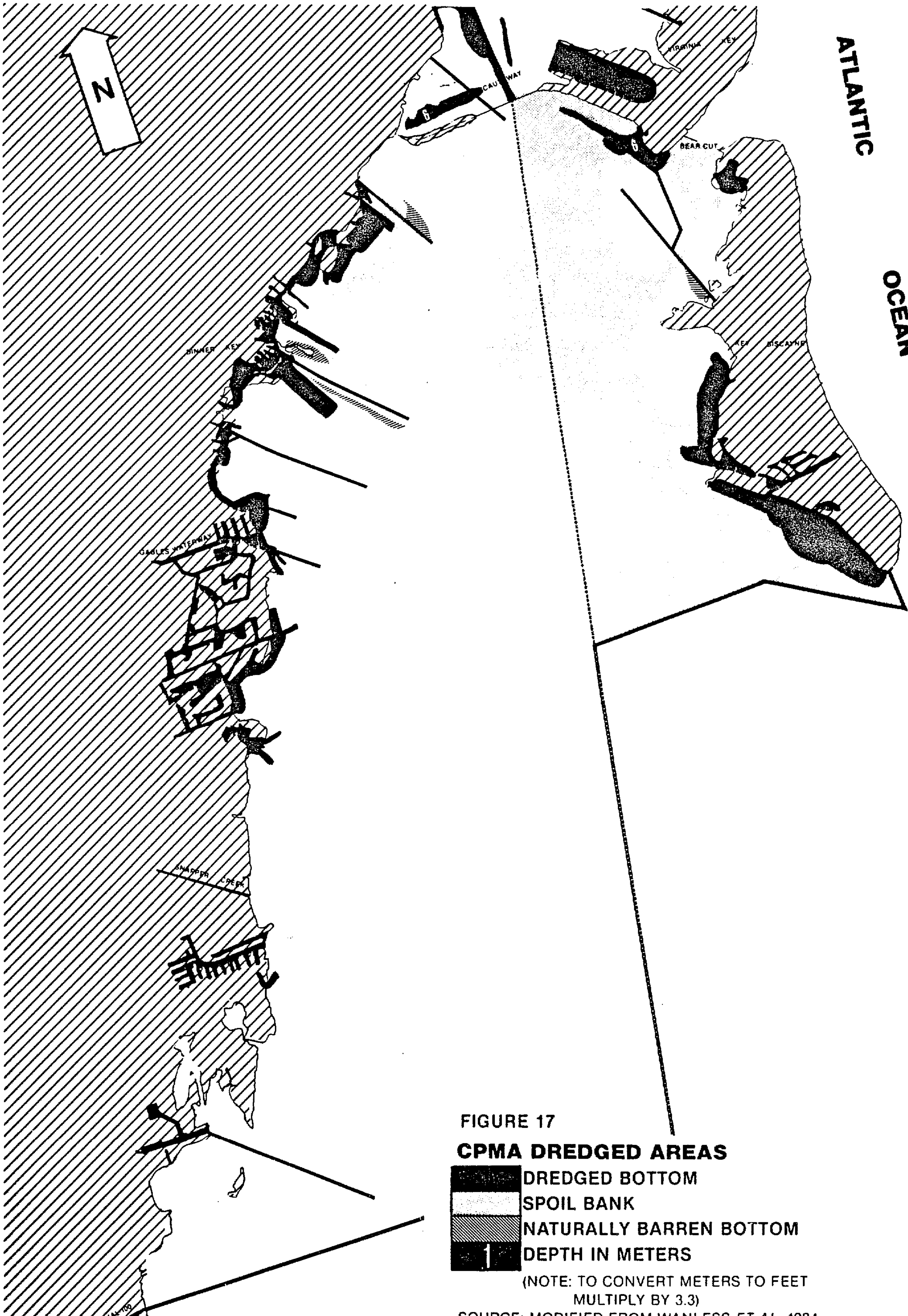


FIGURE 17

CPMA DREDGED AREAS

DREDGED BOTTOM

SPOIL BANK

NATURALLY BARREN BOTTOM

1 DEPTH IN METERS

(NOTE: TO CONVERT METERS TO FEET MULTIPLY BY 3.3)

SOURCE: MODIFIED FROM WANLESS *ET AL*. 1984

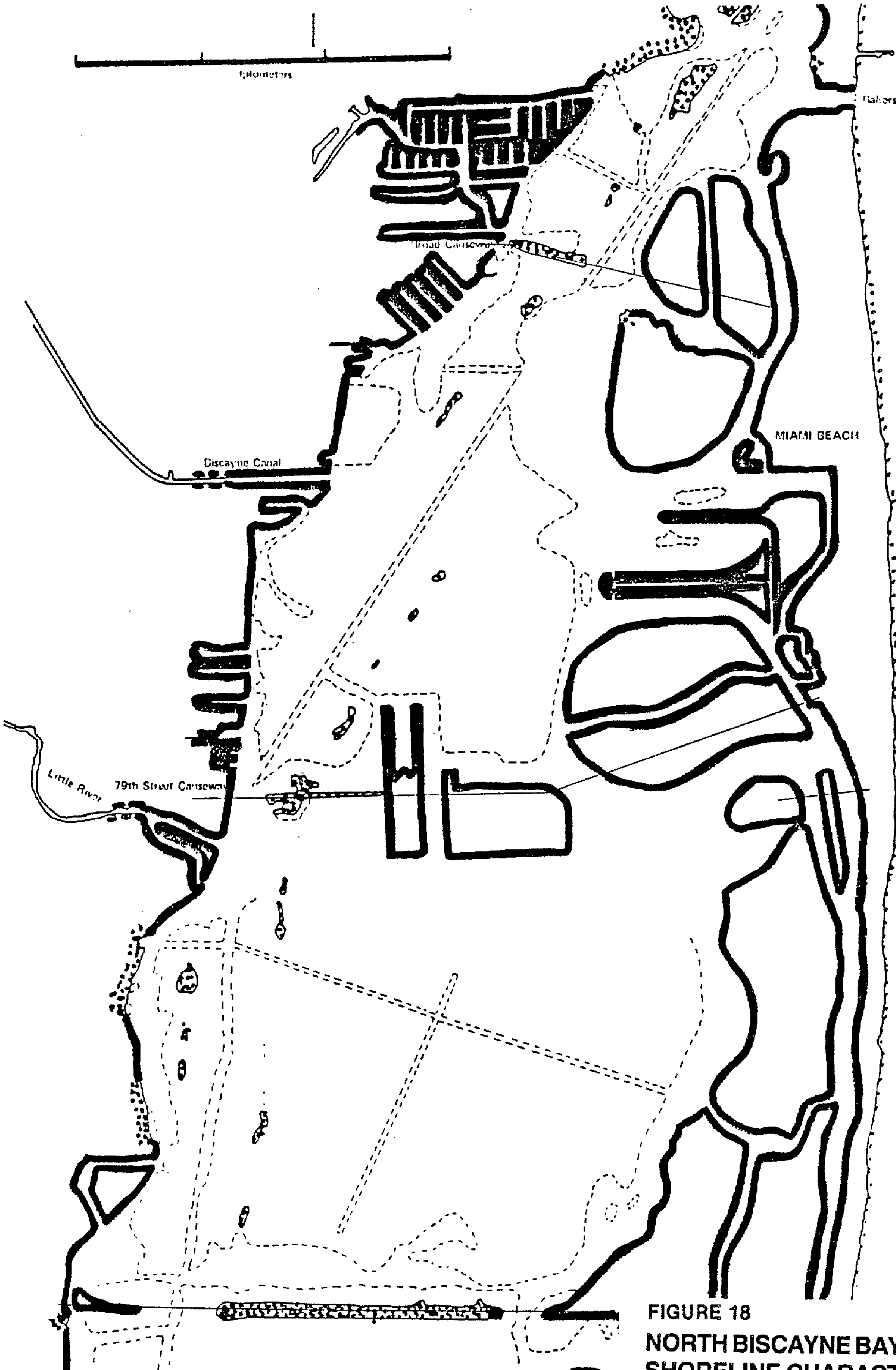


FIGURE 18
NORTH BISCAYNE BAY
SHORELINE CHARACTERISTICS (UNITS I-III)

- VERTICAL SEAWALLS
- MIXED SAND & GRAVEL FILL
- MANGROVES

SOURCE: WANLESS _ET AL_, 1984

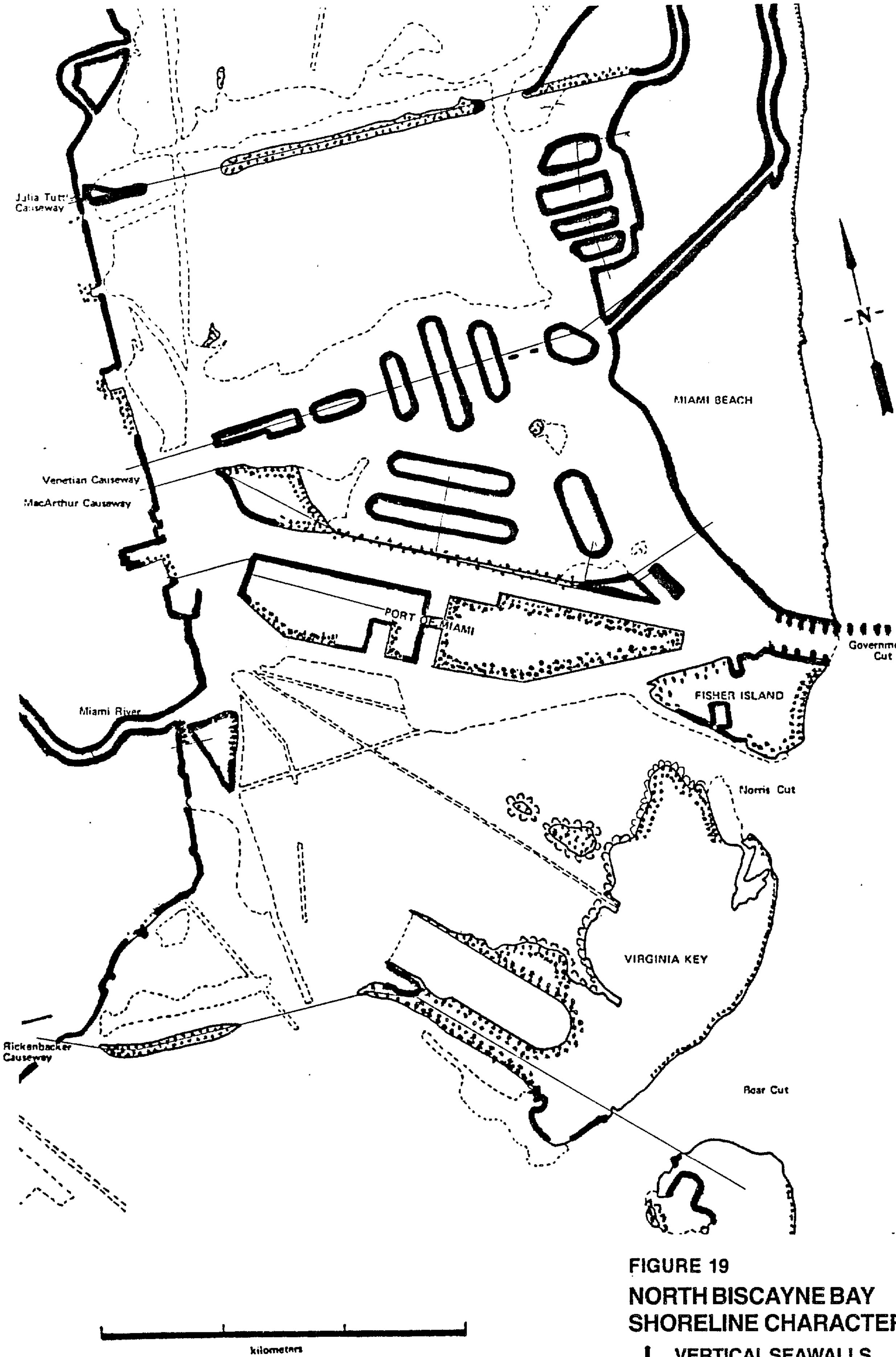


FIGURE 19
NORTH BISCAYNE BAY
SHORELINE CHARACTERISTICS (UNITS III-VII)

VERTICAL SEAWALLS
MIXED SAND & GRAVEL FILL
MANGROVES
RIPRAP

SOURCE: MODIFIED FROM WANLESS ET AL, 1984

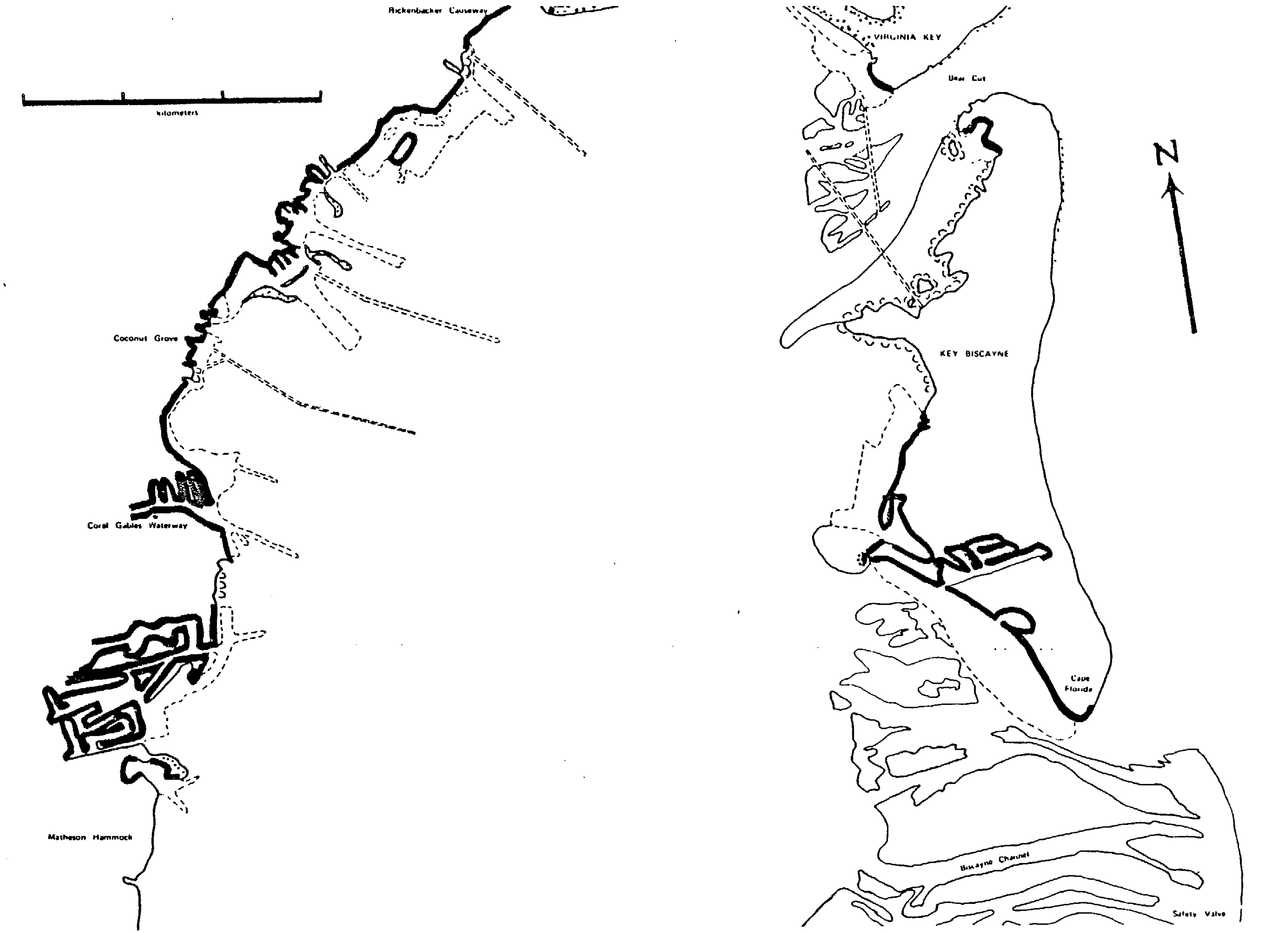


FIGURE 20

CPM AREA SHORELINE CHARACTERISTICS

VERTICAL SEAWALLS

MIXED SAND & GRAVEL FILL

MANGROVES

SOURCE: WANLESS ET AL, 1984

WATER QUALITY

The Metro-Dade Department of Environmental Resources Management (DERM) has been monitoring water quality within the APMA on a monthly basis since March 1979 (see Figure 21), and in the Miami River since April 1984. Water quality in the Bay did not change markedly from 1979 through 1984, however some trends have been identified, especially in the APMA (Metro-Dade County DERM, 1985).

Dissolved Oxygen

During the period from 1979 through 1983 dissolved oxygen (D.O.) concentrations in Biscayne Bay ranged from 1.9 to 9.7 mg/L (milligrams per liter). The highest mean D.O. concentration (6.8 mg/L) was recorded at Elliott Key Harbor and the lowest mean D.O. concentration (4.8 mg/L) was recorded at the Dade/Broward County line. Within the APMA the highest average D.O. values (6.6 mg/L) were recorded in the algal/grass flat north of the Julia Tuttle Causeway, and the lowest mean D.O. values were recorded at the mouth of the Miami River. By comparison, mean D.O. concentrations at mid-depth in Tampa Bay from 1981 through 1983 generally ranged from 5 to 7 mg/L (Hillsborough County, 1982 and 1984); and annual mean D.O. for 1979-1983 in the coastal waters of Manatee County, Florida, ranged from 5.7 to 6.8 mg/L (Larkin, 1984).

D.O. concentration declined an average 0.3 mg/L/yr. at 11 stations in the APMA from 1979 through 1983 (Figure 22). These stations are located at canal mouths, over seagrass beds, barren bottom in channels and within an inlet. Although these declines were statistically significant, the reason for them is unclear (DERM, 1985).

Nutrients

The concentrations of nitrate/nitrite nitrogen and phosphate phorphorus, dissolved nutrients that can stimulate algal blooms, are greater in the NPMA than in either the CPMA or in south Bay. Since 1979 nitrate concentrations have increased at eight stations, including five locations in the NPMA, the station at the mouth of Snapper Creek, one mid-Bay station outside the APMA and the station in Dumfoundling Bay north of the APMA (see Figure 23).

Nitrate plus nitrite nitrogen concentrations in Biscayne Bay ranged from less than 0.01 mg/L to 1.40 mg/L from 1979 through 1983. Mean values ranged from a low of 0.03 mg/L at nine stations within the APMA to a high of 0.16 mg/L at Mowry Canal, which drains a large agricultural area. It appears that the majority of nitrate is removed from the water column either through biological uptake or dilution prior to entering Biscayne Bay. Concentrations of nitrate nitrogen reported for Tampa Bay and Manatee County waters are comparable to those in Biscayne Bay.

Phosphate phosphorus concentrations in Biscayne Bay during the 1979-1983 period ranged from 0.001 mg/L to 0.122 mg/L. High levels of phosphate were detected in the ICW near Broward County, and in canal discharges. The combined mean value from canal stations was three times background levels. The highest concentration of phosphate in the NPMA were in Unit II and on the western side of Unit III.

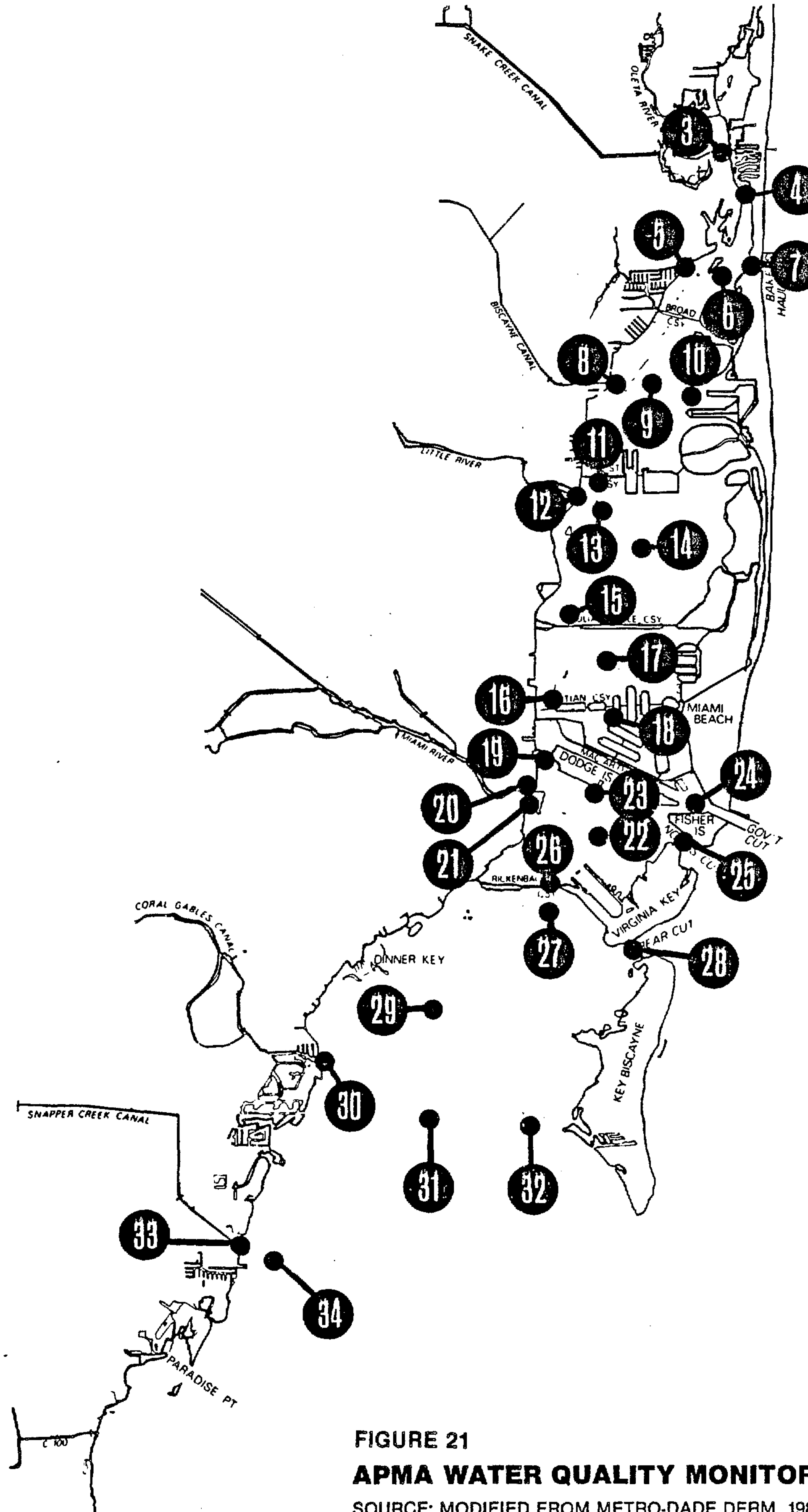


FIGURE 21
APMA WATER QUALITY MONITORING STATIONS
SOURCE: MODIFIED FROM METRO-DADE DERM, 1985

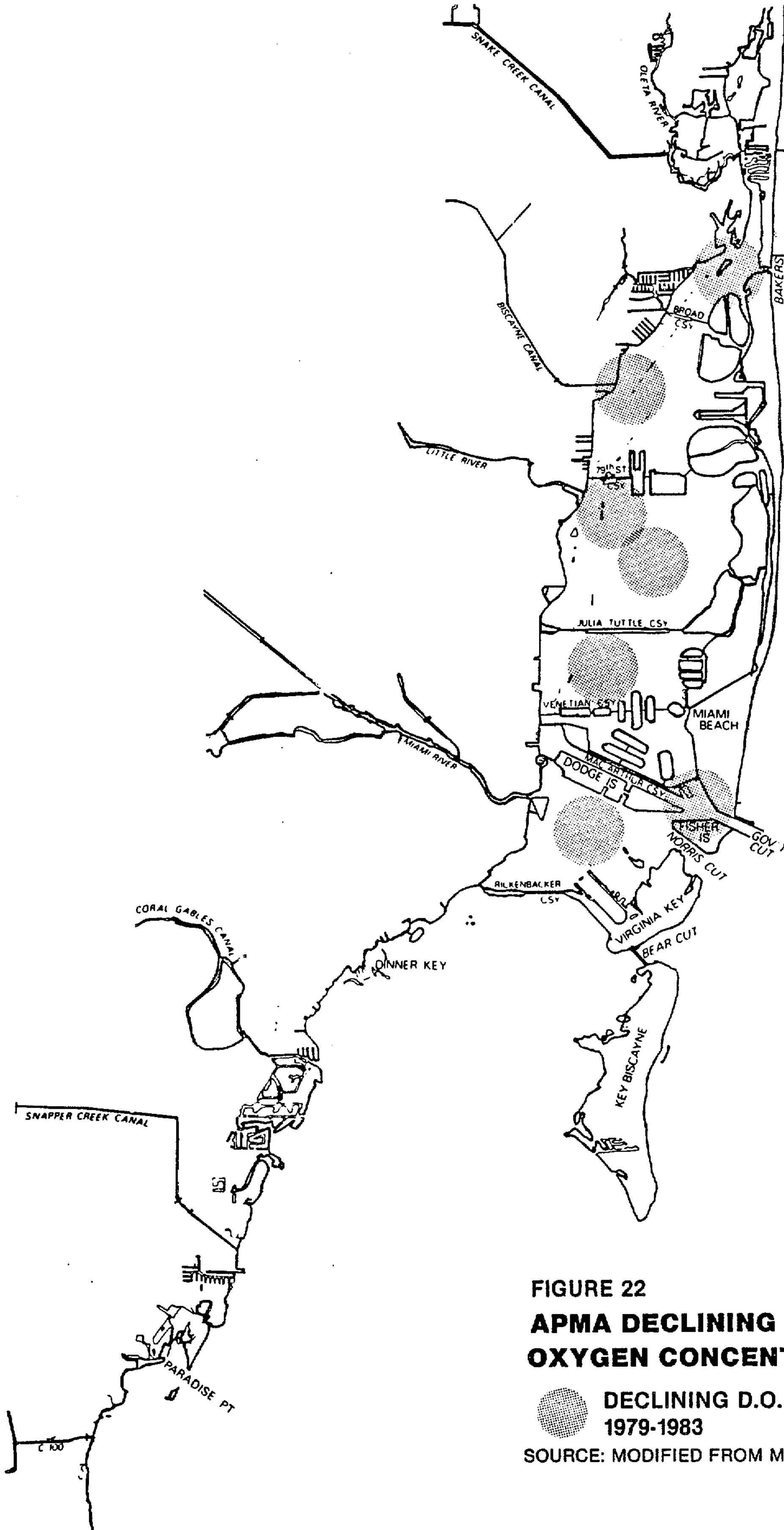


FIGURE 22
APMA DECLINING DISSOLVED OXYGEN CONCENTRATIONS

DECLINING D.O. CONCENTRATIONS 1979-1983

SOURCE: MODIFIED FROM METRO-DADE DERM, 1985

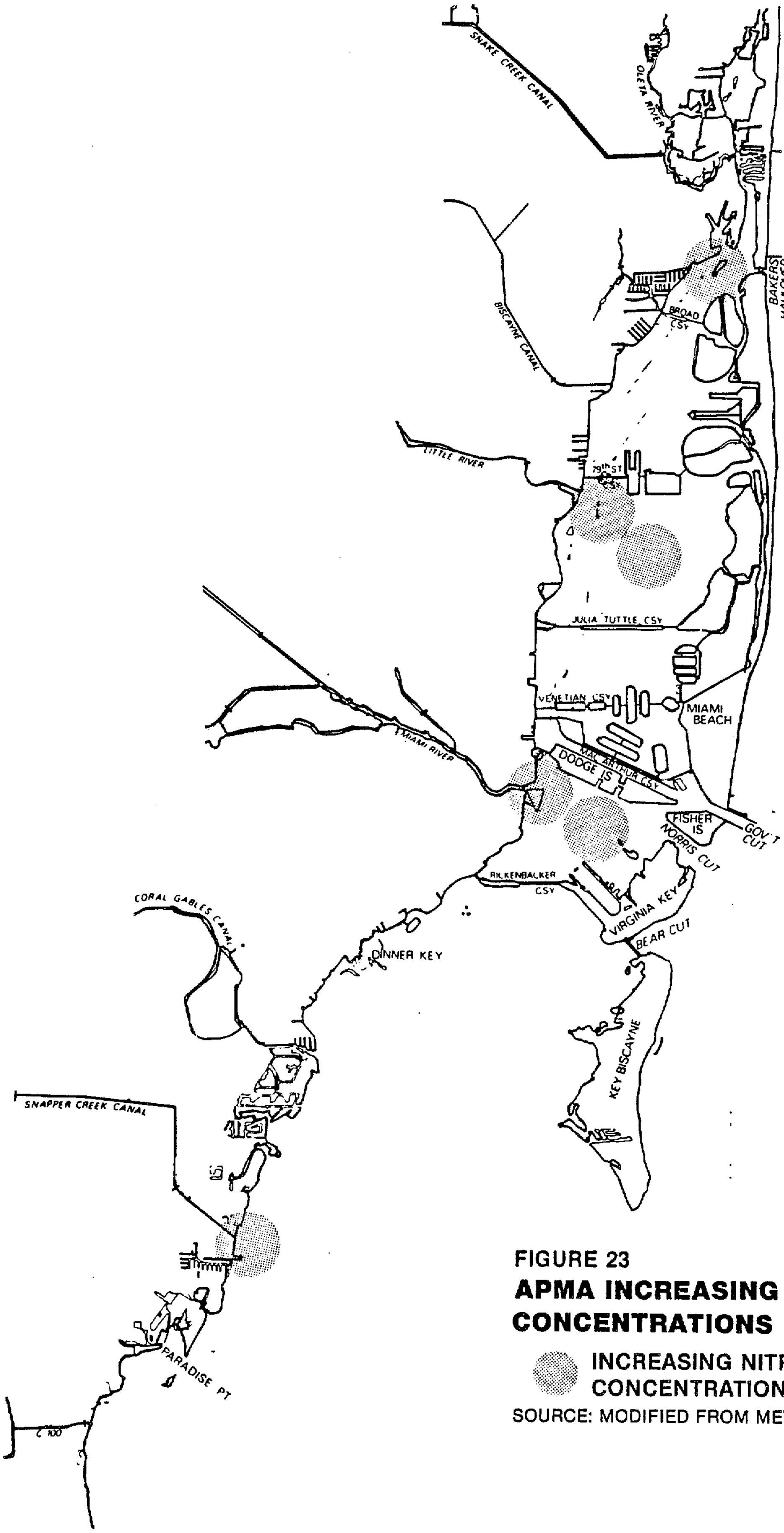


FIGURE 23
APMA INCREASING NITRATE/NITRITE CONCENTRATIONS

INCREASING NITRATE/NITRITE CONCENTRATIONS; 1979-1985

SOURCE: MODIFIED FROM METRO-DADE DERM, 1985

Three large areas of the APMA showed declining trends in phosphate concentrations from 1979-1983. The northernmost area including Units I and II and the mouth of Little River experienced a decrease of approximately 0.006 mg/L/yr. Decreases of approximately 0.002 mg/L/yr. were also reported for Unit VI, Government Cut, the Miami River and the northern half of the CPMA.

Chlorophyll

Chlorophyll a concentrations were sampled in Unit II, in Unit VI, in Featherbed Bank, and in Card Sound. Mean chlorophyll a ranged from 0.58 ug/L (micrograms per liter) at the station in Card Sound and 0.72 ug/L in Featherbed Bank to 4.83 and 4.19 ug/L in Units II and IV, respectively. The two values in the NPMA are significantly higher than those in south Biscayne Bay/Card Sound. By comparison, chlorophyll a concentrations reported in Tampa Bay during 1981-1983 averaged between 4.37 - 44.45 ug/L.

Metals

Monthly water column sampling for cadmium, copper, iron, lead and zinc were conducted in Biscayne Bay from May 1980 through August 1981, and then quarterly through 1983. The concentrations of these metals varied widely (DERM, 1985).

Cadmium. Median cadmium concentrations ranged from 0.02 ug/L at Black Creek south of the APMA to 0.06 ug/L in the middle of Unit III. However, there were no statistically significant differences between cadmium values at the stations sampled. By comparison, average cadmium values at Jacksonville were approximately 0.04 ug/L and at Tampa 0.086 ug/L. A range of 0.03 - 0.43 is reported for Pensacola. Southeast U.S. coastal waters contained between 0.01 to 0.03 ug/L and average concentrations of ocean water is approximately 0.01 ug/L (as reported in DERM, 1985). Therefore, there appears to be some cadmium contamination in Biscayne Bay, however, the concentrations are well below the 5.0 ug/L established Water Quality Standard (WQS).

Copper. Median copper values in Biscayne Bay ranged from 0.4 ug/L in the Featherbed Bank to 1.6 ug/L at the mouth of the Miami River. By comparison, southeastern coastal waters generally contain between 0.06 ug/L to 0.45 ug/L copper. While copper values in Biscayne Bay were generally higher than those found in other Florida waters, even the values at the mouth of Miami River were well within the established Water Quality Standard for copper of 15.0 ug/L.

Iron. Average iron values ranged from 1.0 ug/L in the Featherbed Bank to 31.0 ug/L at the mouths of the Little and Miami Rivers. A significant difference exists between the iron values at canals and those detected in other areas of the Bay.

In Jacksonville and Tampa, iron concentrations ranged from 1.7-21.0 ug/L and 1.8-10.0 ug/L, respectively, in 1982-83. Within southeastern U.S. coastal waters, iron concentrations range from 0.30 - 5.60 ug/L. The levels of iron in Biscayne Bay vary from background in south Bay to concentrations as high as those found within any major Florida port (Ryan et al, 1985). However, the Water Quality Standard for iron is almost ten times the maximum concentrations observed in Biscayne Bay.

Lead. Median values for lead in Biscayne Bay during the 1980-1983 period ranged from 0.3 ug/L in Card Sound to 1.1 ug/L at the mouth of Miami River. Concentrations in the canals and Dumfoundling Bay are significantly higher than those found at mid-bay stations. By comparison, lead concentrations at Pensacola ranged from 0.20 ug/L to 0.47 ug/L. Jacksonville coastal waters averaged 0.08 - 0.26 ug/L with reported values up to 6.9 ug/L (Ryan et al, 1985). Tampa Bay averaged 0.032 - 0.112 ug/L. It is apparent that Biscayne Bay waters have some lead contamination.

Zinc. Median values of zinc ranged from 6 ug/L in the Featherbed Bank south of the APMA to 14.0 ug/L in Dumfoundling Bay north of the APMA. Unlike the distributions of iron and lead, water column concentrations of zinc did not vary greatly between Bay waters and canal stations even though Corcoran and co-workers (1984) reported high concentrations in canal sediments.

Zinc concentrations in Biscayne Bay were generally higher than those in other Florida coastal waters. The highest zinc values reported for Pensacola, Jacksonville and Tampa were 3.5 ug/L, 4.7 ug/L and 3.4 ug/L respectively. Southeast coastal waters are reported to contain between 0.49 ug/L to 6.2 ug/L zinc and the average concentration in ocean waters is approximately 0.10 ug/L.

Coliform Bacteria

Geometric mean values of total coliform concentrations in Biscayne Bay from 1979 through 1983 ranged from 1 per 100 ml to 3756 per 100 ml. The highest values were found at the mouths of canals and the lowest were in areas with good exchange with ocean waters.

Fecal coliform values are generally considered to be more indicative of human waste contamination than total coliform values. Geometric mean values ranged from none detected west of Key Biscayne and in central and south Bay outside the APMA to 825 per 100 ml at the mouth of the Miami River.

State and County Water Quality Standards are based upon concentrations of coliform bacteria present in the water column. The tests are widely utilized and easily performed. However, mounting evidence suggests that coliform bacteria are not the best indicators of human sewage contamination in marine waters (Cabelli 1983, Dutka 1973, Lessard and Sieburth 1983), as they die off quickly in saltwater. In Biscayne Bay where gradients exist from low salinity waters to ocean salinities, results of coliform tests may be misleading. For example, a sewage source in a canal where freshwater is present may indicate much higher coliform values than an identical source in the Atlantic Ocean.

In 1985, DERM contracted for two monitoring projects to assess sanitary conditions within the Biscayne Bay area and to evaluate potential indicators of human sewage inputs. One project being undertaken by Spectrum Labs of Ft. Lauderdale, is analyzing the presence and concentrations of bacteriophages and other microorganisms in Bay area waters. The second project is being done by Mote Marine Laboratories of Sarasota to address the feasibility of using the mammalian fecal steroid, coprostanol, as an indicator of sewage impacts, particularly in areas with poor tidal flushing and where sources of sewage contamination may be expected to occur. Surface sediments were sampled at fifty-eight locations throughout the Bay area in 1985-86. Forty-seven of the stations were within the APMA.

Preliminary findings indicate that the NPMA stations exhibited the highest levels of coprostanol. Concentrations ranged from below the level of detection in the ocean inlets where fine grained sediments do not accumulate, to a high of 4,809 ng/g (one billionth of a gram of coprostanol per gram of sediment material) near 2nd Avenue in the Miami River. Other areas with high coprostanol levels (e.g. more than 1000 ng/g) were the ICW at the Dade/Broward County line, Big Maule Lake Marina, Haulover Marina in Unit I, Flamingo Marina in Unit III, Western Turning Basin in Unit VI, seven stations in the Miami River and the area between Brickell Key and the mainland south of the River in Unit VII. Twenty-one of the forty-seven APMA stations sampled had relatively low levels of coprostanol (e.g. below 500 ng/g) (see Figure 24).

This project established the relative concentrations of coprostanol in surface sediments throughout Biscayne Bay and its major tributaries. These preliminary data indicate that sewage contamination has occurred in several parts of the Bay. Information on the sediment content, tidal currents and sources of sewage inputs will be used in establishing a more targeted and intensive second year sampling program (Pierce and Brown, 1986).

Water Clarity

Three different measures of water clarity are recorded by DERM. Turbidity is commonly measured by recording the amount of light that is reflected in the water column and is expressed in nephelometric units (NTU). Suspended particles are measured by filtration and weighing the Total Non-filterable Residue (TNR). Color in the water column is measured against standardized reference cells in the laboratory which are expressed in Platinum Cobalt Units (PCU).

Color. Natural decomposition of vegetation produces organic compounds such as tannin that cause the brownish color observed in north Biscayne Bay and its tributaries. Diatoms and phytoplankton also contribute to color in the water column.

Colored water limits the wavelengths and intensity of light that are available for growth of benthic vegetation. The areas of the Bay that have the poorest circulation are most affected by color. Baywide color values ranged from 0-40.0 PCU from 1979-1983. Mean values ranged from 2.8 PCU in south Biscayne Bay to 13.3 PCU in Dumfoundling Bay north of the APMA. The average value for the nine major canals (Oleta River, Arch Creek, Biscayne Canal, Little River, Miami River, Coral Gables Waterway, Snapper Creek, Black Creek, Mowry Canals) that empty into Biscayne Bay was 8.7 PCU. Unit II had higher average values (7.2 PCU) than any other

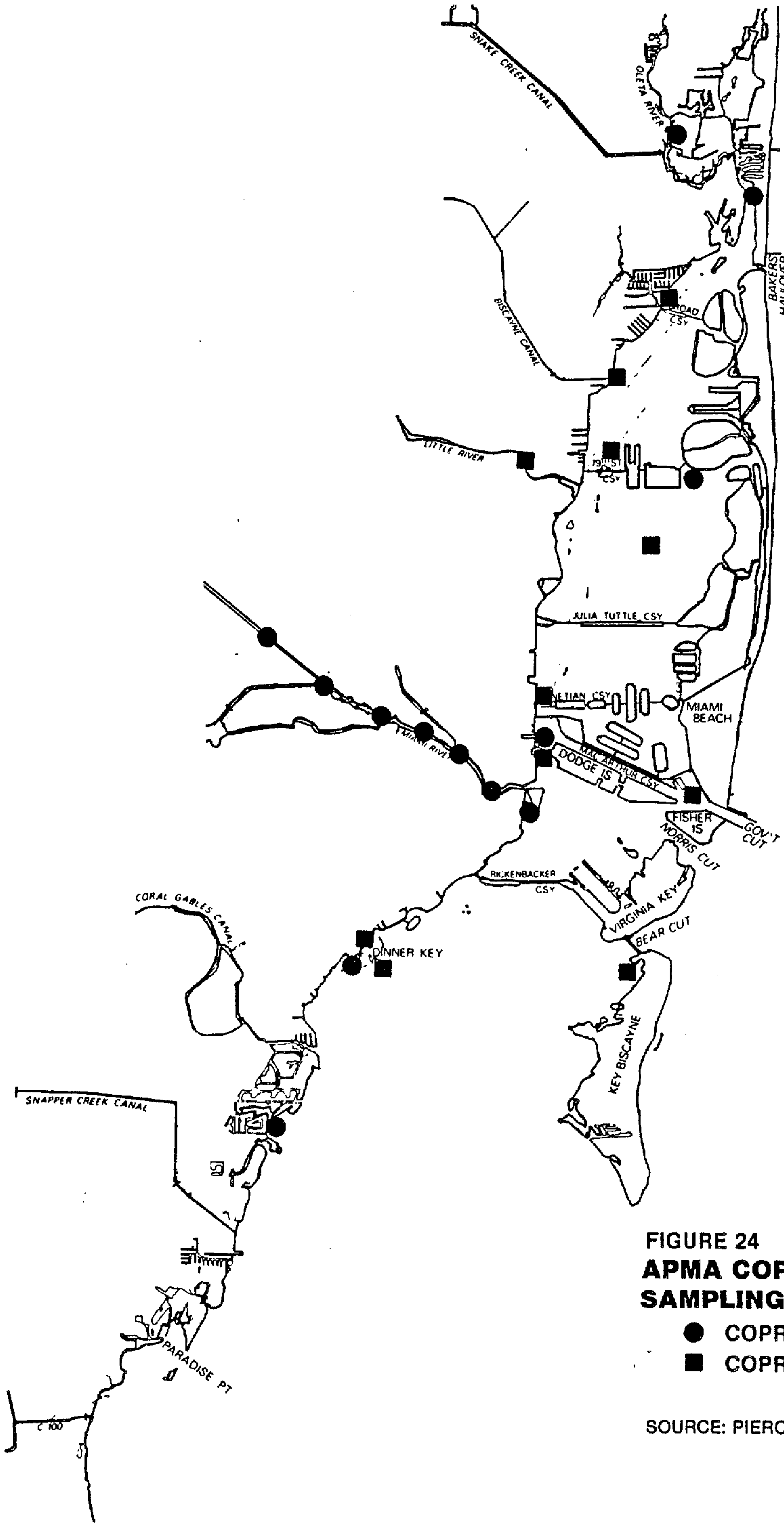


FIGURE 24
APMA COPROSTANOL SAMPLING STATIONS

● COPROSTANOL ≥1000 ng/g
■ COPROSTANOL 500 ng/g-1000 ng/g

SOURCE: PIERCE & BROWN, 1986

unit in the APMA outside of the canals. These values are comparable to Tampa Bay, but lower than PCU levels recorded in Sarasota Bay during the some time period.

Total Non-filterable Residue. Total non-filterable residue (TNR), or suspended solids, ranged from 0.0 to 348.0 mg/L in Biscayne Bay over the 1979-1983 period. Suspended sediments in Biscayne Bay are predominantly fine calcium carbonate particles. The larger particles are broken bits of mollusks, foraminifera and other skeletal grains or bits of limestone. The finer are mostly tiny needle shaped particles produced by calcareous green algae, and rounder particles are of skeletal or limestone origin.

Due to large variances, median rather than mean values are used to describe ambient TNR. Median values ranged from 4.0 mg/L in the ICW near the northern County line to 22.0 mg/L immediately south of the Miami River mouth and in Angelfish Creek in south Biscayne Bay. Ninety-two percent of the Bay stations had median values within a range from 8.0 to 18.0 mg/L. Overall, the TNR values indicate that factors affecting the Bay in general, such as winds and tides, are the primary determinants of TNR values.

Turbidity. Turbidity values in Biscayne Bay ranged from 0.0 to 72.0 NTU over the 1979-1983 period. The State Water Quality Standard is 50 NTU. The lowest median values were reported in south Biscayne Bay outside the APMA. The highest median values were recorded in the mouth of the Biscayne Canal, on the eastern side of Unit II near the tidal nodal point and at the mouth of the Little River Canal. High ambient values were also observed in a broad area from the Little River north into Unit II, from the mouth of the Miami River extending out into Units IV and V and in the ICW west of Haulover Inlet. All except the latter are areas with soft, fine sediments. As noted previously, the elevated turbidity levels in Unit II are attributable to the minimal flushing near the tidal nodal point.

The lowest turbidity levels in the APMA were observed in Government Cut and in the broad grass/algal bank in the middle of Unit III. This shallow, densely vegetated area lies just a short distance from stations which registered much higher turbidity levels. The contrast is a demonstration of the effectiveness of turbidity attenuation by bottom vegetation.

Biscayne Bay, south of Rickenbacker Causeway has distinctly lower prevailing turbidity than found in the NPMA. However, the area just south of Rickenbacker Causeway and the area just west of Southwest Point on Key Biscayne have persistently higher turbidity levels than elsewhere in the CPMA. These areas are associated with deeper, barren muddy bottoms. These isolated areas are influenced by several factors including shoreline erosion and re-suspension of bottom fine sediments brought about by the action of wind, tides and boat traffic. The deeper seagrass covered portions of central Biscayne Bay also have higher turbidity levels than those over shallower seagrass areas or areas with only a thin veneer of sand over limestone bedrock.

Mean turbidity levels over a period from Fall 1981 through late Summer 1983 are mapped in Figure 25. Figures 26 and 27 show the areas of the Bay that are most prone to wave and current re-suspension during north-east and northwesterly winds of 20-25 knots.

Factors that Affect Water Clarity. Several factors affect water clarity including bottom and shoreline conditions and water circulation patterns. Significant correlations with salinity, temperature, or water density were not observed by Wanless (1984) although these parameters, together with wind and rainfall, were important in influencing turbidity distribution during specific sampling periods. As noted previously, shallow, heavily vegetated submerged areas serve as areas of sediment accumulation during normal weather conditions.

Artificial channels and dredged depressions were created with little or no regard for current flow or stability of the edge or margin. Unless stabilized, each margin of a dredged depression or artificial channel, is a likely site for erosion. These submerged margins are less visible than shorelines but there are many more miles of sub-tidal channels and dredged areas than spoil shoreline in NPMA. Figures 14 and 15 show the sub-tidal spoil areas in the NPMA.

The almost 120 miles of seawalls and riprapped shorelines within the APMA provide locations for barnacle, mollusk and sponge attachment. These organisms serve important filtering functions as part of their normal feeding behavior, as well as contributing shell and skeletal fragments to the sediment regimes in the Bay. Seawalls are also subjected to erosive action of animals that bore into the cement or rock causing fragments to be released.

Unlike vertical seawalls, riprapped areas contribute to the cleaning or filtering of the water column by attenuating the energy waves reflected from the shoreline and by decreasing bottom scour or erosion at the base of the seawall. Riprapped areas also provide a much larger intertidal area than would a similar length of seawall, thereby allowing for greater attachment of filtering organisms and algae which serve as baffles for suspended particles in the water column.

Mangrove forests also influence water clarity. Murky water carried into a mangrove swamp during a flood tide is cleaned by the filtering of organisms that live on the mangrove roots and swamp floor. Some of the suspended particles settle out in the baffle of pneumatophores, finger like projections that cover the forest floor in black mangrove areas. Ebb tide waters are commonly crystal clear during winter storms when mangrove swamps receive elevated tidal flooding and trap the contained turbidity.

Storm water runoff from canals and roadways has a pronounced effect on water clarity in the APMA. Runoff from an I-95 bridge north of downtown Miami was monitored during five storms from 1979 through 1981 (McKenzie and Irwin, 1983). During the period of sampling, the average daily traffic counts were about 70,000. It was estimated that an average of 28 pounds of total solids and seven pounds of suspended solids were discharged, per storm, per acre of bridge surface. As much as 17 percent of

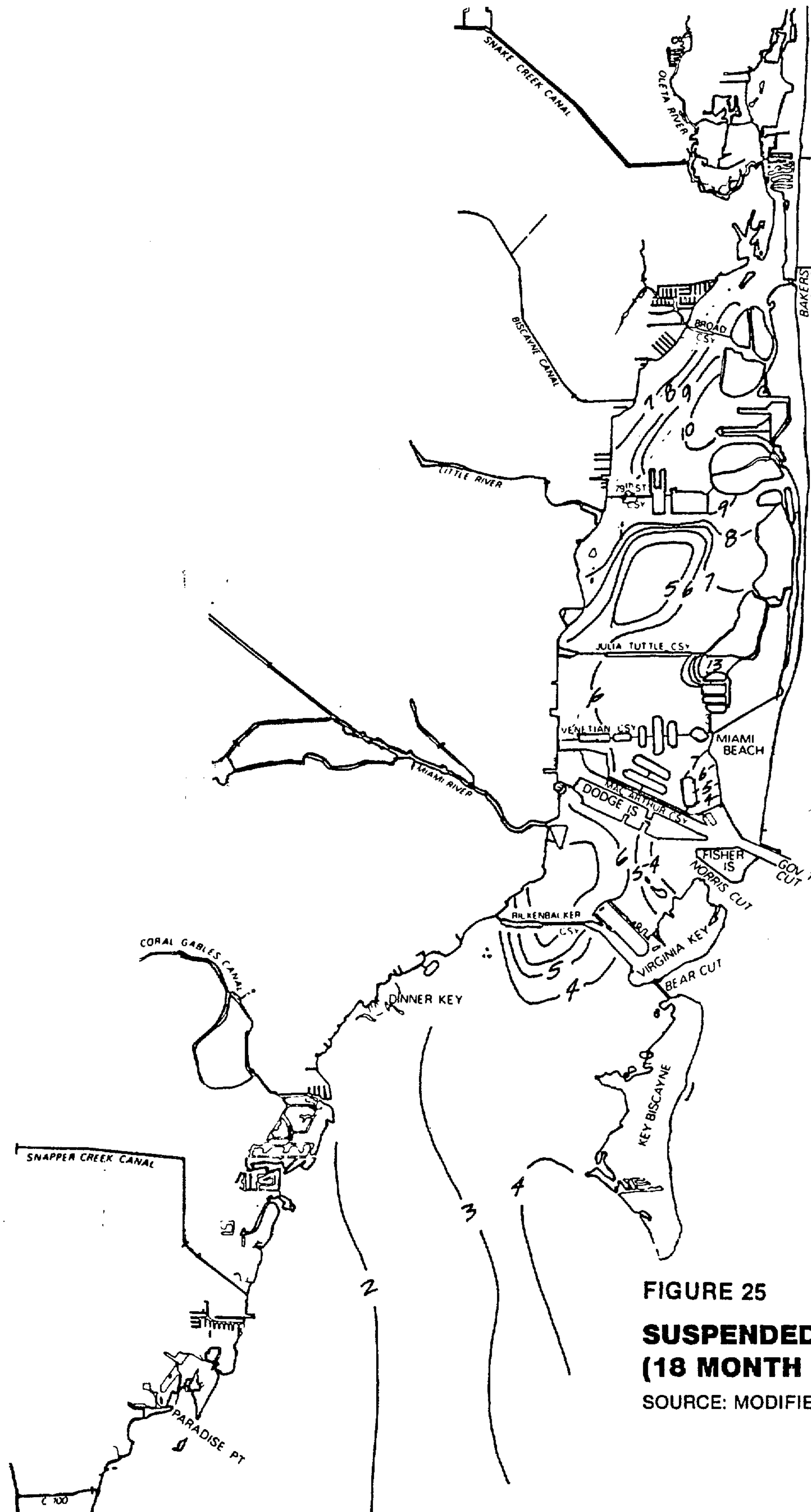


FIGURE 25

SUSPENDED PARTICULATES (18 MONTH MEAN)MG/L

SOURCE: MODIFIED FROM WANLESS *ET AL*, 1984

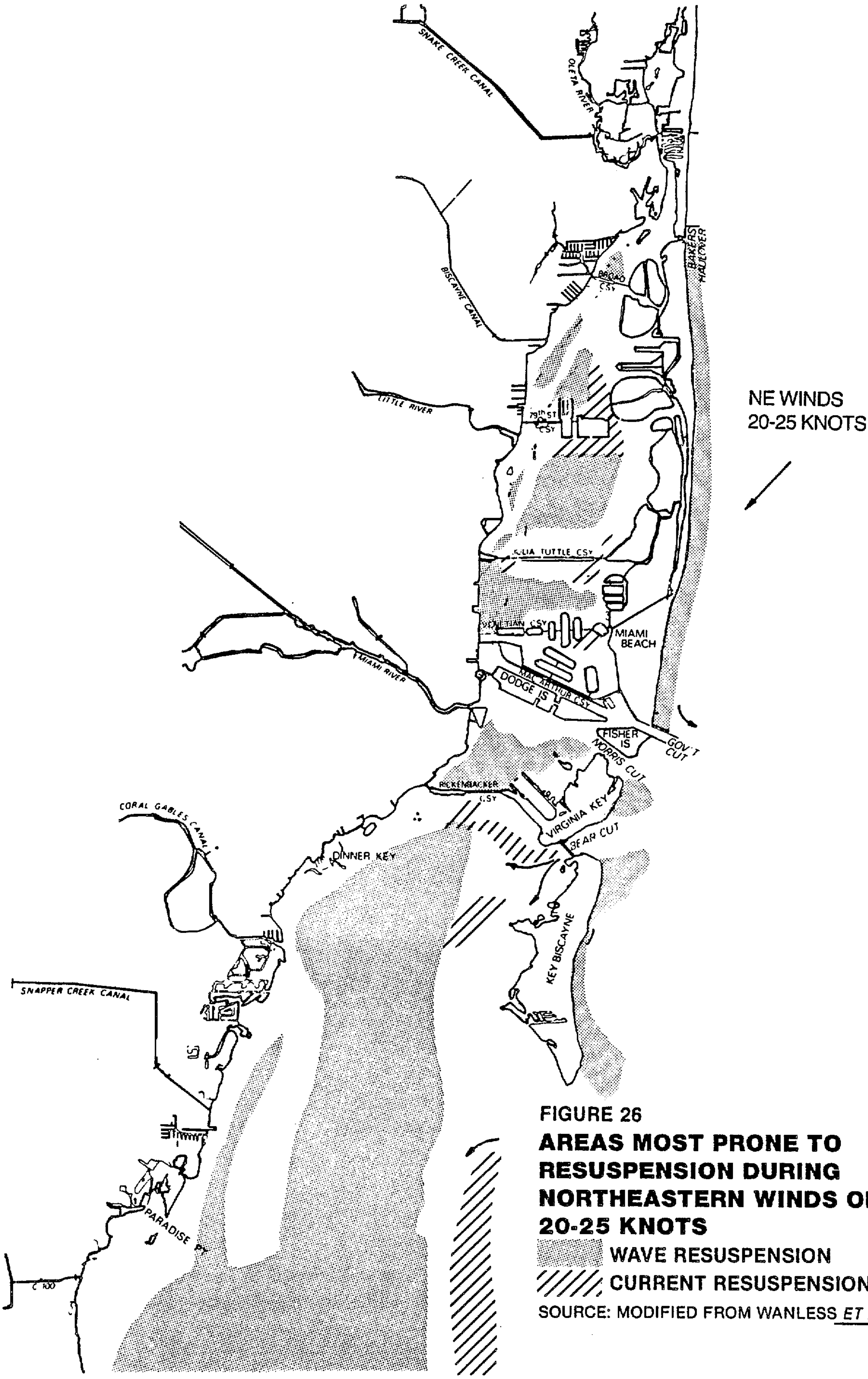


FIGURE 26

AREAS MOST PRONE TO RESUSPENSION DURING NORTHEASTERN WINDS OF 20-25 KNOTS

WAVE RESUSPENSION

CURRENT RESUSPENSION

SOURCE: MODIFIED FROM WANLESS *ET AL.* 1984

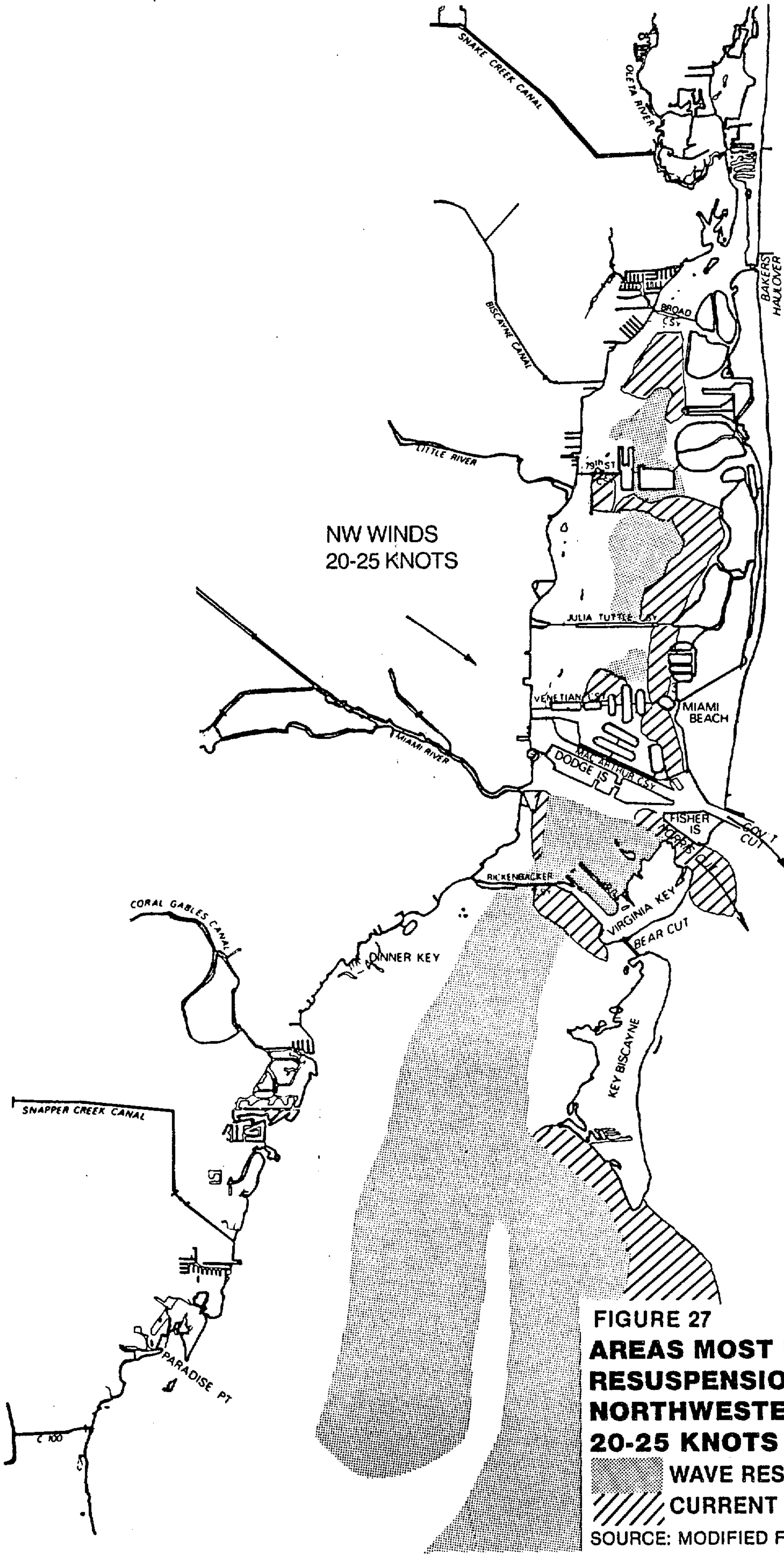


FIGURE 27
AREAS MOST PRONE TO RESUSPENSION DURING NORTHWESTERLY WINDS OF 20-25 KNOTS

SOURCE: MODIFIED FROM WANLESS *ET AL.* 1984 the total solids and 13 percent of the suspended solids may have been derived from the precipitation. During high intensity storms 60 percent of the suspended solids were measured during the initial four minutes of sampling, while during low intensity storms, only about 15 percent of the total load of suspended solids was detected during the first four minutes of sampling. However, the concentrations of most of the parameters measured were quite variable both during individual storm events and among the five storms.

These data are consistent with numerous studies that have described the chemical and physical parameters in roadway runoff. The quantity and composition of contaminants are dependent on many factors including season, weather, traffic volume, surrounding land uses, and the composition of the roadway surface (Gupta, Agnew and Kobringer, 1981).

Overall Water Quality

Overall water quality in Biscayne Bay was determined by combining the 1979-1983 mean or median values for salinity, D.O., turbidity, TNR, color phosphate and total coliform. Good water quality is defined as high in salinity and dissolved oxygen and low in turbidity, TNR color, phosphate and total coliform; while poor water quality is the reverse. On this basis, the best water quality in the NPMA occurred in the middle of Unit III, from Haulover Inlet southward along the east side of the Bay, and from Norris Cut southward through the eastern side of the Unit VII. All of the CPMA from Bear Cut south fell into the "overall good water quality" category. Poorest water quality was located at the mouths of the Little River and the Miami River (figure 28) (DERM, 1985).

Three major factors affect water quality in Biscayne Bay. First the rivers and canals which discharge into the APMA (Oleta River, Arch Creek, Biscayne Canal, Little River, Miami River, Coral Gables Waterway, Snapper Creek) have, in general, a recognizable and negative impact on water quality, especially in the NPMA. Second, reduced water clarity is present in areas that have barren bottoms and finer grained sediments as opposed to vegetated bottoms. Third, restricted circulation in northern Biscayne Bay tends to retain nutrients, organics and fine grained particulates which degrade water quality (DERM, 1985).

SEDIMENT QUALITY

Organic compounds and metals are poorly soluble in water. Consequently, these substances tend to bind to particles that are suspended in the water column and become concentrated on the bottom as the particles settle. The sediments within the Aquatic Preserve Management Area have thus become a sink for these compounds and provide a long-term record of their introduction into the Bay environment (Corcoran et al, 1984).

Corcoran and his co-workers (1984) analyzed 55 sediment samples from throughout Biscayne Bay for heavy metals and synthetic organic compounds including insecticides, herbicides, polychlorinated biphenyls (PCB's), and phthalic acid esters (PAE's). Twenty-seven of the sites sampled were within the APMA.

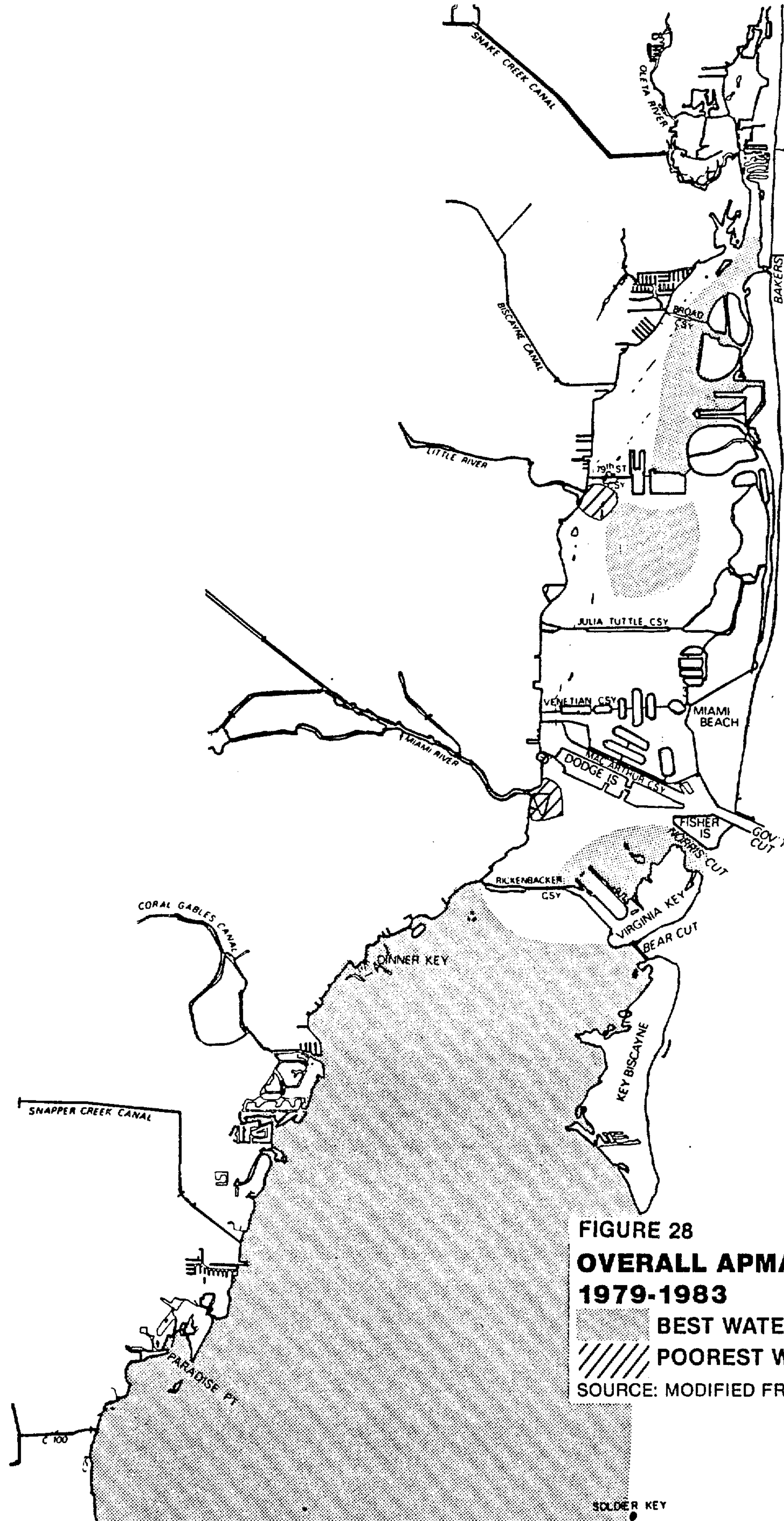


FIGURE 28
OVERALL APMA WATER QUALITY; 1979-1983

BEST WATER QUALITY

POOREST WATER QUALITY

SOURCE: MODIFIED FROM METRO-DADE DERM, 1985

PAE's

Of the synthetic organic compounds, PAE's were the most widely distributed. These substances occurred in 96 percent of the sites sampled Bay-wide and 93 percent of the samples analyzed from within the APMA (Table 2). This distribution is not surprising, since PAE's are extensively used in the production of polyvinyl chloride and other plastics. However, their concentration in some Bay samples was many times higher than in similar environments in other parts of the United States (Table 3) (Corcoran, Brown and Freay, 1984).

Herbicides

Herbicides were detected in 78 percent of the sites sampled Bay-wide and in 70 percent of the samples from the APMA (Table 4). The highest levels occurred in canals and rivers, but significant concentrations were also found in the Bay. Their widespread distribution is expected, since herbicides are extensively used in agriculture and by homeowners. The parent compounds are broken down by bacteria and usually persist in the soil for a few weeks to one year (Corcoran, Brown and Freay, 1984).

PCB's

Prior to 1970, PCBs were used in the United States in hydraulic fluids, transformers and capacitors, and as plasticizers. Due to their persistence in the environment and toxicity at high levels, their use has been restricted. PCB's were found in 69 percent of the Bay-wide samples and in 71 percent of the sediment samples within the APMA. They were concentrated primarily in north Biscayne Bay and in canals and rivers (Table 5). Concentrations of PCB's in some Bay sediments were more than ten times higher than PCB concentrations reported from Galveston Bay, the Mississippi delta or the Gulf coast (Corcoran, Brown and Freay, 1984).

In a study of twelve deep-water ports in the State of Florida, Ryan et al. (1985) reported that only at the Port of Miami were detectable levels of PCB's recorded. Five of the fifteen sites sampled in and around the Port of Miami in 1983 had detectable levels of PCB's. In a second year study of the Miami River, all the sites sampled had detectable levels of PCB's ranging from 0.40 ug/g at approximately NW 36 Avenue to 1.2 ug/g in the Tamiami Canal.

Insecticides

Organochlorine insecticides, including Heptachlor epoxide, Dieldrin, Endosulfan, DDT and its breakdown products DDE and DDD, were detected in 38 percent of the sites sampled Bay-wide and 34 percent of the sites sampled within the APMA (Table 6). Aldrin, Toxaphene and Methoxychlor were not detected in any of the sediments tested. Dieldrin was not detected within the APMA, but was detected in one site south of the APMA in the Featherbed Banks. Most of the insecticides detected are no longer in use or are restricted; therefore, over time their levels are expected to decline (Cocoran, Brown and Freay, 1984).

TABLE 2

PHTHALIC ACID ESTERS (PAE) CONCENTRATIONS IN SURFACE SEDIMENTS IN BISCAYNE BAY AQUATIC PRESERVE

	Station Number	Phthalic Acid Esters[a] (ug/g) BBP	DIBP	DBP	DEHP	DEP
NORTH PRESERVE MANAGEMENT AREA						
Venetian Island	32	ND[b]	ND	ND	ND	ND
North of DiLido Island	35	0.10	ND	ND	ND	ND
West of Venetian	36	0.46	ND	ND	1.69	ND
West of Julia Tuttle	38	ND	ND	ND	ND	ND
South of North Bay Island	43	0.12	ND	ND	ND	ND
Bird Key	44	0.56	ND	ND	4.99	ND
West of Haulover Park	47	0.11	ND	ND	0.65	ND
East of Miami River	74	0.95	ND	ND	0.77	ND
Government Cut	75	1.20	ND	6.36	3.35	ND
Spoil Area Northeast of Biscayne Canal	78	0.55	ND	ND	4.22	ND
Baker's Haulover	152	0.29	ND	ND	0.62	2.04
Biscayne Point	155	0.08	ND	3.18	15.53	ND
Oleta River	46	2.05	ND	ND	13.28	ND
Arch Creek North	51	1.94	ND	ND	18.40	ND
Arch Creek South	54	1.16	ND	ND	7.74	ND
Miami River	61	0.77	ND	ND	1.70	ND
Miami River Mouth	62	0.16	ND	ND	0.11	ND
Little River	137	0.45	ND	ND	12.39	ND
Indian Creek	140	0.29	ND	ND	1.38	ND
Indian Creek	143	0.19	ND	ND	2.05	ND
CENTRAL PRESERVE MANAGEMENT AREA						
Crandon Marina	4	0.12	ND	ND	6.48	ND
Southwest of Key Biscayne	8	0.27	ND	ND	ND	ND
East of Dinner Key	23	0.41	ND	0.81	1.48	ND
South of Rickenbacker	27	0.68	ND	5.86	3.08	ND
Chicken Key	72	1.19	ND	3.83	4.60	ND
Matheson Hammock Channel	73	0.86	ND	ND	4.97	ND
Gables Waterway	66	0.08	ND	2.04	0.75	ND
	27[c]	25/27[d]	0/27	6/27	22/27	1/27
Range of Values		ND-2.05	ND	ND-6.36	ND-18.40	ND-2.04

[a]BBP = Butylbenzyl Phthalate
DBP = Di-butyl Phthalate
DEHP = Di-ethylhexyl Phthalate
DEP = Di-ethyl Phthalate
DIBP = Di-isobutyl Phthalate

[b]ND = None Detected

[c]Total number of stations sampled in APMA

[d]Number of stations where compound was detected in APMA/Total number of Stations in APMA

Source: Modified from Corcoran et. al., 1984.

TABLE 3

PHTHALIC ACID ESTERS (PAE'S) CONCENTRATIONS
IN SURFACE SEDIMENTS FOR SELECTED LOCATIONS

	Phthalic Acid Esters[a] (ug/g)			
	DIBP	DEP	DEHP	DBP
Chesapeake Bay[b]	0.006	0.022-.042	0.012-.180	0.027-.089
Galveston Bay[c]			0.001-.110	
Mississippi Delta[d]			0.0001-.248	0.0001-.052
Gulf Coast[d]			0.003-.014	0.0001-.015
Biscayne Bay Aquatic Preserve[e] (APMA)				
North Preserve Management Area (NPMA) (20 stations)	N.D. (0/20)[f]	N.D.-2.04 (1/20)	N.D.-18.40 (16/20)	N.D.-6.36 (2/20)
Central Preserve Management Area (CPMA) (7 stations)	N.D. (0/7)	N.D. (0/7)	N.D.-6.48 (6/7)	0-5.86 (4/7)

[a]DBP = Di-butyl Phthalate
DEHP = Di-ethylhexyl Phthalate
DEP = Di-ethyl Phthalate
DIBP = Di-isobutyl Phthalate

[b]Peterson and Freeman, 1982

[c]Murray et al., 1981

[d]Giam et al., 1978

[e]Corcoran et al., 1984

[f](Number of stations where compound was detected/Total number of stations in area)

N.D. = None detected

Source: Modified from Corcoran et. al., 1984

TABLE 4

HERBICIDE CONCENTRATIONS IN SURFACE SEDIMENTS
IN BISCAYNE BAY AQUATIC PRESERVE

	Station Number	2,4-D	Silvex (ng/g)	2,4,5-T
NORTH PRESERVE MANAGEMENT AREA				
Venetian Island	32	ND	0.46	ND
North of DiLido Island	35	ND	0.44	ND
West of Venetian	36	ND	ND	3.42
West of Julia Tuttle	38	1.28	0.53	ND
South of North Bay Island	43	ND	0.28	ND
Bird Key	44	8.04	1.54	ND
West of Haulover Park	47	0.11	0.22	0.11
East of Miami River	74	ND	ND	ND
Government Cut	75	6.86	3.68	ND
Spoil Area Northeast of Biscayne Canal	78	6.06	ND	1.92
Baker's Haulover	152	ND	ND	ND
Biscayne Point	155	ND	ND	2.58
Oleta River	46	0.50	ND	0.26
Arch Creek North	51	ND	ND	ND
Arch Creek South	54	ND	ND	ND
Miami River	61	ND	4.07	ND
Miami River Mouth	62	ND	ND	ND
Little River	137	ND	ND	44.60
Indian Creek	140	ND	ND	ND
Indian Creek	143	ND	ND	ND
CENTRAL PRESERVE MANAGEMENT AREA				
Crandon Marina	4	ND	0.51	ND
Southwest of Key Biscayne	8	0.61	0.51	ND
East of Dinner Key	23	1.67	0.37	0.60
South of Rickenbacker	27	4.42	ND	1.34
Chicken Key	72	ND	ND	2.42
Matheson Hammock Channel	73	ND	ND	ND
Gables Waterway	66	ND	0.60	3.79
	27[b]	9/27[c]	11/27	9/27
Range of Values		ND-8.04	ND-4.07	ND-44.60

[a]ND = None Detected

[b]Total Number of Stations sampled in APMA

[c]Number of Stations where compound was detected in a APMA/Total number of stations in APMA

Source: Modified from Corcoran et. al., 1984.

TABLE 5

POLYCHLORINATED BIPHENYLS (PCBs) CONCENTRATIONS IN SURFACE SEDIMENTS IN BISCAYNE BAY AQUATIC PRESERVE

	Station Number	Aroclor 1016	Aroclor 1254 (ng/g)[a]	Aroclor 1260
NORTH PRESERVE MANAGEMENT AREA				
Venetian Island	32	ND[b]	ND	64.00
North of DiLido Island	35	ND	ND	49.15
West of Venetian	36	124.78	ND	ND
West of Julia Tuttle	38	ND	ND	ND
South of North Bay Island	43	ND	ND	ND
Bird Key	44	ND	ND	ND
West of Haulover Park	47	ND	37.22	ND
East of Miami River	74	ND	54.61	ND
Government Cut	75	ND	ND	ND
Spoil Area Northeast of Biscayne Canal	78	ND	170.96	ND
Baker's Haulover	152	ND	218.55	ND
Biscayne Point	155	ND	26.10	ND
Oleta River	46	ND	ND	ND
Arch Creek North	51	ND	234.82	ND
Arch Creek South	54	ND	31.06	ND
Miami River	61	ND	464.12	ND
Miami River Mouth	62	ND	58.60	ND
Little River	137	ND	21.40	ND
Indian Creek	140	ND	204.93	ND
Indian Creek	143	ND	ND	51.28
CENTRAL PRESERVE MANAGEMENT AREA				
Crandon Marina	4	ND	81.40	ND
Southwest of Key Biscayne	8	ND	33.79	ND
East of Dinner Key	23	ND	307.49	ND
South of Rickenbacker	27	33.86	ND	ND
Chicken Key	72	ND	ND	ND
Matheson Hammock Channel	73	ND	ND	ND
Gables Waterway	66	ND	ND	ND
	27[c]	2/27[d]	14/27	3/27
Range of Values		ND-124.78	ND-464.12	ND-64.00

[a] ng/g = One billionth of a gram of compound/gram of sediment
1 ug (microgram) = 1000 ngs
[b] ND = None Detected
[c] Total Number of Stations sampled in APMA
[d] Number of Stations where compound was detected in a APMA/Total number of stations in APMA

Source: Modified from Corcoran et. al., 1984.

TABLE 6

ORGANOCHOLORINE INSECTICIDES CONCENTRATIONS IN SURFACE SEDIMENTS IN BISCAYNE BAY AQUATIC PRESERVE

	Station Number	Epoxide Heptachlor	Endosulfan	DDT	DDE	DDD
				ng/g		
NORTH PRESERVE MANAGEMENT AREA						
Venetian Island	32	ND[a]	ND	ND	ND	ND
North of DiLido Island	35	ND	ND	ND	ND	ND
West of Venetian	36	ND	ND	ND	ND	ND
West of Julia Tuttle	38	ND	ND	ND	10.0	ND
South of North Bay Island	43	ND	ND	ND	15.0	ND
Bird Key	44	31.8	ND	ND	ND	ND
West of Haulover Park	47	ND	ND	ND	ND	ND
East of Miami River	74	ND	ND	ND	ND	ND
Government Cut	75	ND	ND	ND	ND	ND
Spoil Area Northeast of Biscayne Canal	78	ND	ND	ND	ND	ND
Baker's Haulover	152	ND	ND	ND	ND	ND
Biscayne Point	155	ND	ND	ND	ND	ND
Oleta River	46	ND	ND	4.5	9.8	3.8
Arch Creek North	51	ND	ND	ND	ND	ND
Arch Creek South	54	ND	ND	ND	ND	ND
Miami River	61	ND	ND	ND	ND	ND
Miami River Mouth	62	ND	124.2	2.2	ND	2.3
Little River	137	ND	1014.3	52.7	ND	ND
Indian Creek	140	ND	ND	ND	ND	ND
Indian Creek	143	ND	ND	ND	ND	ND
CENTRAL PRESERVE MANAGEMENT AREA						
Crandon Marina	4	ND	ND	ND	ND	ND
Southwest of Key Biscayne	8	ND	ND	ND	ND	ND
East of Dinner Key	23	ND	ND	ND	ND	ND
South of Rickenbacker	27	ND	ND	ND	ND	ND
Chicken Key	72	ND	ND	ND	13.9	ND
Matheson Hammock Channel	73	ND	ND	ND	6.3	ND
Gables Waterway	66	ND	ND	ND	3.0	ND
	27[b]	1/27[c]	2/27	3/27	6/27	1/27
Range of Values		ND-31.8	ND-1014.3	ND-52.7	ND-15.0	ND-3.8

[a] ND = None Detected
[b] Total Number of Stations sampled in APMA
[c] Number of Stations where compound was detected in a APMA/Total number of APMA stations sampled.

Source: Modified from Corcoran _et. al._, 1984.

In the Florida Deepwater Ports Study, Ryan et al. (1985) found detectable levels of Aldrin and DDT in three sites sampled from the Miami River, but not in four sites sampled in Unit VI or the seven sites sampled in Unit VII. The values detected for DDT were .07 - .14 ug/g and .004 - .06 ug/g for Aldrin. In addition, chlordane was detected at two of the River Stations in values of .07 and .16 ug/g.

Metals

Metals that were detected in excess of natural background levels in Biscayne Bay were chromium, copper, mercury, lead and zinc (Cocoran, Brown and Freay, 1984). Six sampling sites within the APMA contained no detectable amounts of any of the metals analyzed. These sites included two marinas, two canal or river mouths, one site in the Intracoastal Waterway and one near Chicken Key. Arsenic and cadmium were below the detection level in all area samples analyzed by Corcoran and his co-workers (1984).

As shown in Table 7, metals were detected in 19 out of 20 sites sampled in the NPMA. The highest concentrations were found in the Miami River, Arch Creek North, the Oleta River, Indian Creek and in the vicinity of the Venetian Isles.

Chromium. Chromium is widely distributed in low concentrations in soils and vegetation. It is toxic to animals. It is used in industrial processes such as electroplating, printing, fungicides, and the manufacture of alloys. Another major source is particle emission from rubbish burning. Chromium was detected in nine out of 27 sites in APMA. Maximum values were detected in the Arch Creek North and Miami River sites.

Copper. Copper is essential in many biological processes including the settling of barnacles, spinning of threads in mussels, synthesis of hemoglobin and also in the activation of certain plant enzymes. However, it can become harmful in aquatic environments in excessive amounts. Copper is used as fungicide and insecticide and in the manufacturing antifouling paints for boats. As with chromium, the maximum levels of copper found in the APMA were detected in the Miami River and Arch Creek North sites.

Mercury. Mercury is derived from industrial processes including plastic and drug manufacturing, and contamination resulting from incidental disposal of water based paints, paper products, cosmetics, broken thermometers, pharmaceuticals and agricultural and residential runoff. Three sample sites within the APMA contained detectable mercury concentrations. The Arch Creek North site was four and one-half times background levels.

Lead. The two most widespread sources of lead are exhaust fumes from internal combustion engines and paints. Lead is also used in batteries, pigments, dying, glass and pesticides. Lead was detected in eight of the 27 sampling sites within the APMA. At seven of the eight sites elevated concentrations of lead were associated with relatively high concentrations of zinc.

TABLE 7

METAL CONCENTRATIONS IN SURFACE SEDIMENTS
IN BISCAYNE BAY AQUATIC PRESERVE

	Station Number	Chromium	Copper	Mercury (ng/g)	Lead	Zinc
NORTH PRESERVE MANAGEMENT AREA						
Venetian Island	32	8	14	ND[a]	60	18
North of DiLido Island	35	11	14	ND	30	20
West of Venetian	36	ND	ND	ND	ND	8
West of Julia Tuttle	38	ND	16	ND	ND	ND
South of North Bay Island	43	9	ND	ND	ND	ND
Bird Key	44	ND	5	ND	ND	6
West of Haulover Park	47	ND	25	ND	25	ND
East of Miami River	74	ND	8	ND	ND	ND
Government Cut	75	ND	19	ND	12	16
Spoil Area Northeast of Biscayne Canal	78	ND	6	ND	ND	9
Baker's Haulover	152	ND	ND	ND	ND	11
Biscayne Point	155	ND	24	ND	ND	25
Oleta River	46	9	12	0.1	60	15
Arch Creek North	51	19	45	0.9	ND	36
Arch Creek South	54	10	ND	ND	ND	ND
Miami River	61	22	55	ND	50	25
Miami River Mouth	62	NA	ND	ND	ND	ND
Little River	137	NA	8	0.2	32	34
Indian Creek	140	10	12	ND	ND	20
Indian Creek	143	10	ND	ND	80	10
CENTRAL PRESERVE MANAGEMENT AREA						
Crandon Marina	4	ND	ND	ND	ND	ND
Southwest of Key Biscayne	8	ND	ND	ND	ND	ND
East of Dinner Key	23	9	ND	ND	ND	8
South of Rickenbacker	27	ND	6	ND	ND	6
Chicken Key	72	ND	ND	ND	ND	ND
Matheson Hammock Channel	73	ND	ND	ND	ND	ND
Gables Waterway	66	ND	ND	ND	ND	ND
	27[b]	10/27[c]	15/27	3/27	8/27	16/27
Range of Values		ND-22	ND-55	ND-0.9	ND-80	ND-36
Background Values		(7-8)*	(1-30)°	(0.2)*	(16)*	(2)*

[a]ND = None Detected
[b]Total Number of Stations sampled in APMA
[c]Number of Stations where compound was detected in a APMA/Total number of stations in APMA

* = Background values established for the upper Keys, Florida Bay and Biscayne Bay (Manker, 1975)

o = Copper sample values from Florida Key canals (Chesher, 1974).

Source: Modified from Corcoran et. al., 1984.

Zinc. Zinc is essential in many biological processes including the functioning of enzyme systems, but can be a serious environmental pollutant in higher quantities. The major sources of zinc in the environment are sewage, soaps, paints, paper products, dyes, corrosive inhibitors for pipe lines and fossil fuels combustion. Zinc was found in 16 out of 27 sites in the APMA.

The findings presented above are corroborated by two other recent studies done in the NPMA. The first was the Deepwater Port Study done by the Florida Department of Environmental Regulation (Ryan et al, 1985) done during 1983 and 1984. The second was done for the U.S. Army Corps of Engineers by Savannah Laboratories and Environmental Services in 1985.

Ryan, et al. (1985) undertook a sediment study in and around twelve deep water ports within the State of Florida to assist in effectively planning for disposal of dredged material when maintenance dredging is required in the future. An initial sampling in 1983 around the Port of Miami area and an expanded sediment sampling program in the River during April 1984 revealed that sediments along the entire length of the River were extremely contaminated. (see Station Locations in Figure 29).

Concentrations of metals were generally higher in down river sediments and lower up river. However, the highest concentrations of cadmium, copper, mercury and silver and high levels of zinc were found in a tributary of the Miami River, the Tamiami Canal. Extremely high levels of arsenic and chromium were detected in sediments in the Seybold Canal area, which also had high levels of zinc, copper, mercury and lead. Maximum concentrations of lead were detected in the vicinity of SW 2nd Avenue. The concentrations of arsenic, cadmium, mercury, lead, copper and silver were considerably higher than levels detected in other Florida ports by Ryan et al. (1985) (see Table 8).

Hydrocarbons

A two year study was funded by the Florida Department of Natural Resources to analyze and identify the distribution of petroleum derived (petrogenic) and naturally occurring hydrocarbons in Biscayne Bay. During 1981, 155 surface sediments, 27 surface water samples and 21 marine organisms from throughout the Bay area were analyzed for hydrocarbons. Fifty-two of the sediment samples were contaminated with petroleum hydrocarbons (Corcoran et al, 1983). Twenty-seven of the contaminated sites were in the NPMA and nine were located in the CPMA (see Table 9). Total hydrocarbon content for surface sediments ranged from below detection level to 2663.45 ug/g. Only one marine organism, the flat tree oyster was contaminated, but the surface waters in several canals contained petroleum hydrocarbons, in amounts ranging from 0.78 to 64.47 ug/l.

Most of the sediments which contained petroleum contamination were associated with canals that receive runoff from large urbanized areas, and the highest concentrations of hydrocarbons found in the entire Preserve Area were in the sediments and surface waters of Miami River.

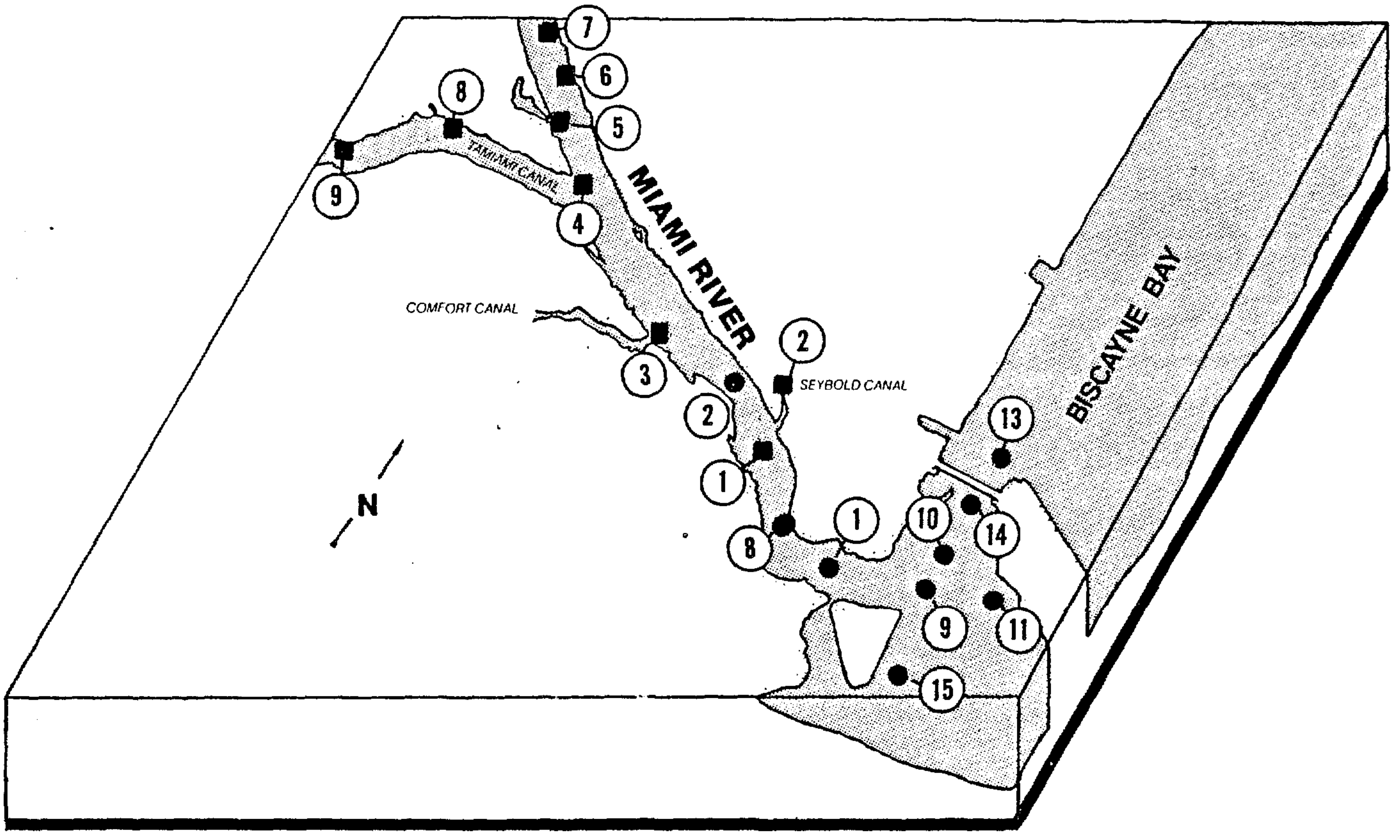


FIGURE 29
MIAMI RIVER AND PORT OF MIAMI SEDIMENT MONITORING STATIONS
● 1983 SAMPLING STATIONS
■ 1984 SAMPLING STATIONS
SOURCE: RYAN, _ET AL_, 1985

TABLE 8

RANGES IN METAL CONCENTRATIONS IN PORT SEDIMENTS
(Concentrations are in ppm)

	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	SILVER	ZINC
Canaveral	5.0-8.1	0.17-3.8	5-100	4-103	7.4-50	0.06-1.1	0.02-0.14	8-220
Ft. Pierce	1.1-9.0	0.01-0.21	2-64	1-36	4.4-39	0.07-0.71	0.01-0.06	1-80
Jacksonville	0.5-6.6	0.03-1.1	3-63	1-33	0.6-64	0.11-1.10	0.01-0.98	3-265
Manatee	0.1-4.6	0.22-0.78	13-57	2-21	3.8-13	0.14-0.31	0.01-0.31	5-77
Port of Miami	1.3-9.8	0.80-2.60	6-30	5-26	9-56	0.17-3.5	0.04-2.50	14-480
Miami River	0.47-16	0.49-18	14-1076	5.5-610	76-980	0.13-36	0.10-6.00	7.9-490
Pensacola	0.1-12	0.17-0.52	5-82	1-17	9-40	0.04-0.79	0.10-0.26	7-95
Port St. Joe	12-19	0.12-0.81	15-77	5-48	8-38	0.10-1.10	0.03-0.17	20-89
Tampa	0.1-9.3	0.60-3.60	60-100	4-130	9-177	0.12-1.20	0.21-1.30	31-385
West Palm Beach	0.6-1.7	0.04-0.92	4-22	1-12	3.5-63	0.10-1.5	0.01-0.04	6-77

Source: Modified from Ryan et al. (1985)

TABLE 9

SURFACE SEDIMENT CONTAINING PETROLEUM HYDROCARBONS COLLECTED DURING 1981

Location	Sample #	Total Hydrocarbons ug/g
North Preserve Management Area		
Between San Marino and Hibiscus Islands	32	124.51
Belle Isle	34	33.08
Westend Ventian Causeway	36	15.75
Spoil Island	45	37.62
Intracoastal Waterway	47	60.04
Spoil Area	48	42.34
Intracoastal Waterway	49	29.28
Canal Mouth	51	73.18
Miami River	56	739.97
Miami River	57	754.39
Miami River	58	608.27
Miami River	59	1026.17
Miami River	60	1465.60
Miami River	61	2663.45
Miami River	62	240.00
Loading area - Belcher Oil	75	377.41
Canal mouth	77	84.76
West end of Julia Tuttle Causeway	80	155.64
Dredged hole	135	244.15
Little River	136	499.95
Little River	137	34.14
Normandy Waterway	138	MD[a]
Lake Surprise	142	314.42
Collins Canal	144	77.71
Junction of Royal Glades Canal and Oleta River	148	329.43
Indian Creek	153	47.90
Biscayne Point	155	MD
Central Preserve Management Area		
Intracoastal Waterway	6	46.18
Intracoastal Waterway	7	38.65
East of Matheson Hammock	11	47.78
Intracoastal Waterway	23	72.25
Shoal Area	24	MD
Rickenbacker Causeway	25	MD
Dinner Key	64	78.20
Coral Gables Canal	66	106.06
Coral Gables by the Sea	68	23.08

[a]MD= missing data

Source: Modified from Corcoran *et al.*, The Miami River sediments had more hydrocarbons, by a factor of 10, than any other sampling station in the entire State of Florida. Hydrocarbon concentrations in the River sediments were as high as those found in the Chesapeake Bay and New York bight areas (Corcoran et al, 1983). Petroleum contamination was found throughout the sediment column in the River due to daily mixing brought about by tug boat prop wash.

Water samples collected from the canals and rivers connected to the Bay consistently showed that concentrations of petroleum in surface waters increased from downstream to upstream. Only in the uppermost reaches of the Little and Miami Rivers was there any indication of petroleum in the surface waters. By the time the water enters the Bay from these rivers, the petroleum contaminants have already left the water column and sunk into the sediments (Corcoran et al, 1983).

Concentration of Organic Materials and Metals in Oysters

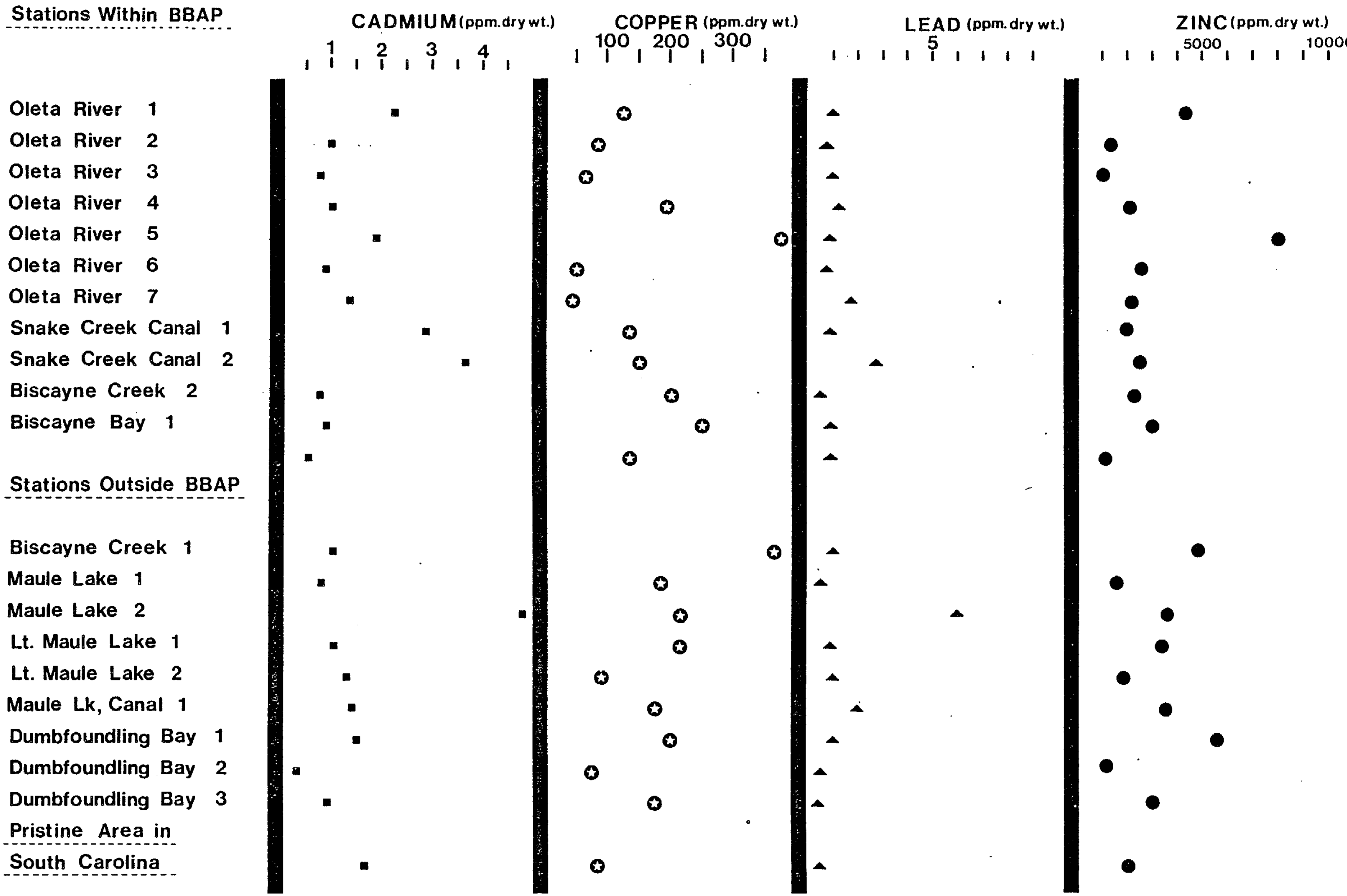
A 1985 study done by the Savannah Laboratories for the U.S. Army Corps of Engineers analyzed concentrations of heavy metals. PCB's and DDT metabolites were found in tissues from oysters taken in stations in the Oleta River, two stations at the mouth of the Snake Creek Canal and two stations from within Biscayne Bay. Observed levels of PCB's and DDT metabolites were relatively low at all stations.

The salinity at the various stations ranged from 2.1 to 28 ppt, but appeared to have little influence upon the levels of metals found. Oysters from three stations downstream from the Snake Creek Canal in the Oleta River and the station at the mouth of Snake Creek had high concentrations of mercury.

Chromium levels were about ten times higher in the oysters sampled from the station in the Oleta River at Biscayne Boulevard than at other stations sampled. The levels of copper and zinc found in oyster tissues at this station were also substantially higher than amounts from oysters at other stations. Relatively high amounts of copper were observed in oysters from several locations in Maule and Little Maule Lakes (outside of the APMA) and in one station from Biscayne Bay just north of Haulover Park. High levels of zinc were also observed in one station in Dumfoundling Bay outside the Preserve.

Very high levels of lead were observed in oysters from Maule Lake, and relatively high levels were observed in samples from the mouth of the Snake Creek and the upper reaches of the Oleta River. Cadmium levels were also elevated in the Snake Creek stations and in two stations from the Oleta River. It is interesting that higher levels of lead were not observed in the oysters from the Biscayne Boulevard station, as lead and cadmium levels appear to be significantly correlated to one another. In general these metals are associated with storm water runoff from urban areas. The results of the oyster analyses are summarized in Figure 30.

Concentrations of Heavy Metals in Tissue of Oysters from the Biscayne Bay Area Compared to a Pristine Control Area in South Carolina



Source: Savannah Laboratories and Environmental Services, Inc. 1985

FIGURE 30

PART III

LIVING RESOURCES OF THE BISCAYNE BAY AQUATIC PRESERVE AREA

PLANKTON

Plankton are free-floating, usually minute, plants or animals that drift in the water column. Planktonic plants (phytoplankton) and animals (zooplankton) play significant roles in the food web of Biscayne Bay.

In coastal waters, the most important groups of planktonic plants are diatoms and dinoflagellates. These microscopic brown-pigmented algae occur as single cells or in chains or small colonies. They are a principal food source for numerous types of zooplankton, including the larvae of many benthic animals. Diatoms are generally most numerous in north Biscayne Bay, with their concentration decreasing toward the south (Wanless, 1984). Roman and co-workers (1983) measured plankton production along an east-west transect through central Biscayne Bay to the Gulf Stream. They found that chlorophyll concentration in the water, an indicator of living phytoplankton biomass, and rate of phytoplankton growth were highest near shore and decreased toward the Gulf Stream. This pattern is probably a consequence of higher inputs of nutrients from terrestrial runoff.

Average phytoplankton production in mid-Bay is low compared to temperate inshore waters. This is not surprising, however, since seagrasses and benthic algae are the primary producers in central and south Biscayne Bay, and thus probably consume the majority of dissolved nutrients available (Roman et al, 1983). In north Biscayne Bay, where diatom and chlorophyll concentrations in the water are higher and seagrasses are less abundant, phytoplankton may be the principal plants in the food web (Reeve, personal communication).

According to Roman and co-workers (1983), total zooplankton biomass in central Biscayne Bay is greatest near the shore and decreases toward the Gulf Stream. This pattern reflects the availability of food. Other studies of south and central Biscayne Bay (Baker, 1973; Houde and Lovdal 1984) show that average zooplankton abundance is lowest in Card Sound and extreme south Biscayne Bay and increases toward the north. Comprehensive studies of north Biscayne Bay zooplankton abundance have not been published; however, Reeve (unpublished data) has observed significantly higher densities of zooplankton in north Biscayne Bay than in central or south Biscayne Bay.

The average zooplankton biomass in central Biscayne Bay is similar to, or greater than, zooplankton biomass in temperate estuaries and coastal waters, despite the fact that phytoplankton, a major source of nutrition for zooplankton, is in relatively low abundance (Roman et al, 1983). Roman and his co-workers suggest that seagrass detritus or benthic algae, which are re-suspended during summer or winter storms (Incze and Roman, 1983), may be an alternate source of food for the zooplankton community.

Copepods, small planktonic crustaceans, and copepod larvae constitute about 60 to 75 percent of the total zooplankton population in central

Biscayne Bay. The larvae of mollusks also represent a significant portion, averaging about 22 to 36 percent of the Bay zooplankton (Roman et al, 1983). These animals which graze on phytoplankton or plant detritus, are the principal sources of food for planktonic fish larvae found in Biscayne Bay (Houde and Lovdal, 1984).

Houde and Lovdal (1984) sampled planktonic fish larvae at a station in Unit VIII west of Key Biscayne. At this location, larvae of clupeids (herrings, sardines and pilchards), anchovies, dragonets, and gobies accounted for approximately 65 percent of all fish larvae collected. According to the authors, it is likely that other types of fish that inhabit the Bay as juveniles or adults may spawn offshore, and their offspring may enter the Bay at a post larval stage in their life cycles. Total numbers of fish eggs and larvae were greatest in the spring and summer, coinciding with seasons of high phytoplankton and zooplankton abundance.

BENTHIC COMMUNITIES

Seagrasses found within the APMA include turtle grass (*Thalassia testudinum*) with ribbon-like leaves; manatee grass (*Syringodium filiform*) with long, thin round leaves; shoal grass (*Halodule wrightii*) with narrow flat leaves; and a species of *Halophila* which are ephemeral grasses with flat, elongated paired leaves. The amount of light, photoperiod, temperature, salinity and sedimentary environments control the growth and distribution of seagrasses. These grasses, together with several species of green, red and brown algae make up benthic plant communities in Biscayne Bay.

Sunlight is the major driving mechanism in the photosynthetic process and is essential to seagrass and algal growth. In the shallow Bay system, the amount of light that is able to penetrate the water column is generally controlled by the clarity of the water column rather than the depth of the water, except in deep dredged areas. As noted previously, water clarity in the Bay is strongly influenced by the re-suspension of fine particles that are largely derived from deposited spoil material, eroding margins of dredged cuts and unconsolidated shorelines. Blooms of tiny plants and algae within the water column also decrease water clarity, but to a much lesser extent than re-suspended inorganic particles (Wanless et al., 1984).

BENTHIC COMMUNITY DISTRIBUTION

Turtle grass predominates in central and south Bay, generally outside of the APMA. Turtle grass growth is generally most dense in areas where there is more than six inches of sand, mud, or muddy sand sediment and where light penetration is not a limiting factor. Offshore from Chapman Field north to the Rickenbacker Causeway, a mixture of seagrasses together with local assemblages of algae overlies the rocky area noted by Wanless et al., (1984) (Figure 16). Along the Bay-ward margin of this rocky grass area is a strip of shoal grass. The middle of the CPMA is barren even though the area has not been dredged (Figure 31).

FIGURE 31
CPMA BENTHIC COMMUNITIES
UNIT VIII

SOURCE: METRO-DADE DERM (1983c.)

On the eastern side of the CPMA mixed seagrasses predominate off the south-west point of Key Biscayne over quartz-carbonate beach sands, and turtle grass dominates to the south and slightly west of Crandon Marina over a similar sedimentary environment. As noted previously, a mixed seagrass bed is developing on the flood delta at Bear Cut.

In summary, the CPMA is covered with 16 percent turtle grass, 47 percent mixed grasses, six percent shoal grass, and three percent algae mixed with seagrass. Twenty-three percent of this area is either dredged or natural barren bottom, and four percent of the area to the east and north of Chicken Key constitutes a hard bottom community where sponges, soft corals, and filtering organisms predominate (Metro-Dade County Planning Department, 1984).

In the NPMA area manatee and shoal grasses predominate wherever light penetration is sufficient to permit plant growth. Species of Halophila are found sporadically in north Bay frequently associated with dredged or nearly barren areas (Metro-Dade County DERM, 1983c). While manatee and shoal grasses are the dominant benthic plants in the NPMA, they comprise slightly less than 24 percent (approximately six and one-quarter square miles) of the total Bay bottom in that area. These grasses together with algae cover an additional eight and one-half percent of the Bay bottom. Thirteen square miles (49 percent) of the NPMA are dredged and barren, and an additional four and one-quarter square miles are naturally barren (Metro-Dade County Planning Department, 1984) (Figures 32, 33 and 34).

As discussed previously, the most extensive and noteworthy grass-algal beds in north Bay are located in Unit III north of the Julia Tuttle Causeway, and on both sides of the Intracoastal Waterway south of Little River adjacent to Bay Point. Other extensive grass beds are located on the lee side of Virginia Key, adjacent to the channel south of the Port, on both sides of the Intracoastal Waterway north of the Rickenbacker Causeway, and south of the Julia Tuttle Causeway on the mainland side bordering the Intracoastal Waterway and on the island side west of Meloy Channel. Further north mixed grasses and algae are found east of the Intracoastal Waterway about one half mile due east of Biscayne Canal and in the undredged areas south of Biscayne Canal.

SEAGRASS REVEGETATION

In October 1980 the Corps of Engineers issued a dredge and fill permit for expansion of the Port of Miami facilities in Biscayne Bay. As a special permit condition the Seaport was required to plant 251 acres of unvegetated or sparsely vegetated Biscayne Bay bottom with the seagrasses to mitigate for damage done to 81 acres of grass beds during the seaport expansion. About two million dollars was allocated for the seagrass planting and monitoring.

Between January and October 1982, 25 acres near Mercy Hospital and 13 one-acre test plots were planted within the APMA. Each of the 13 acre test plots was subdivided into six subplots. In general, two of the subplots were planted in Syringodium shoots, two were planted in Halodule shoots, one was planted in Thalassia shoots, and one was planted in Thalassia seeds. Survival rates were measured about a year after the

FIGURE 32

NPMA BENTHIC COMMUNITIES

UNITS I-II

SEAGRASSES

ALGAE/SEAGRASS

BARREN (DREDGED)

BARREN (UNDREDGED)

SOURCE: METRO-DADE DERM (1983c.)

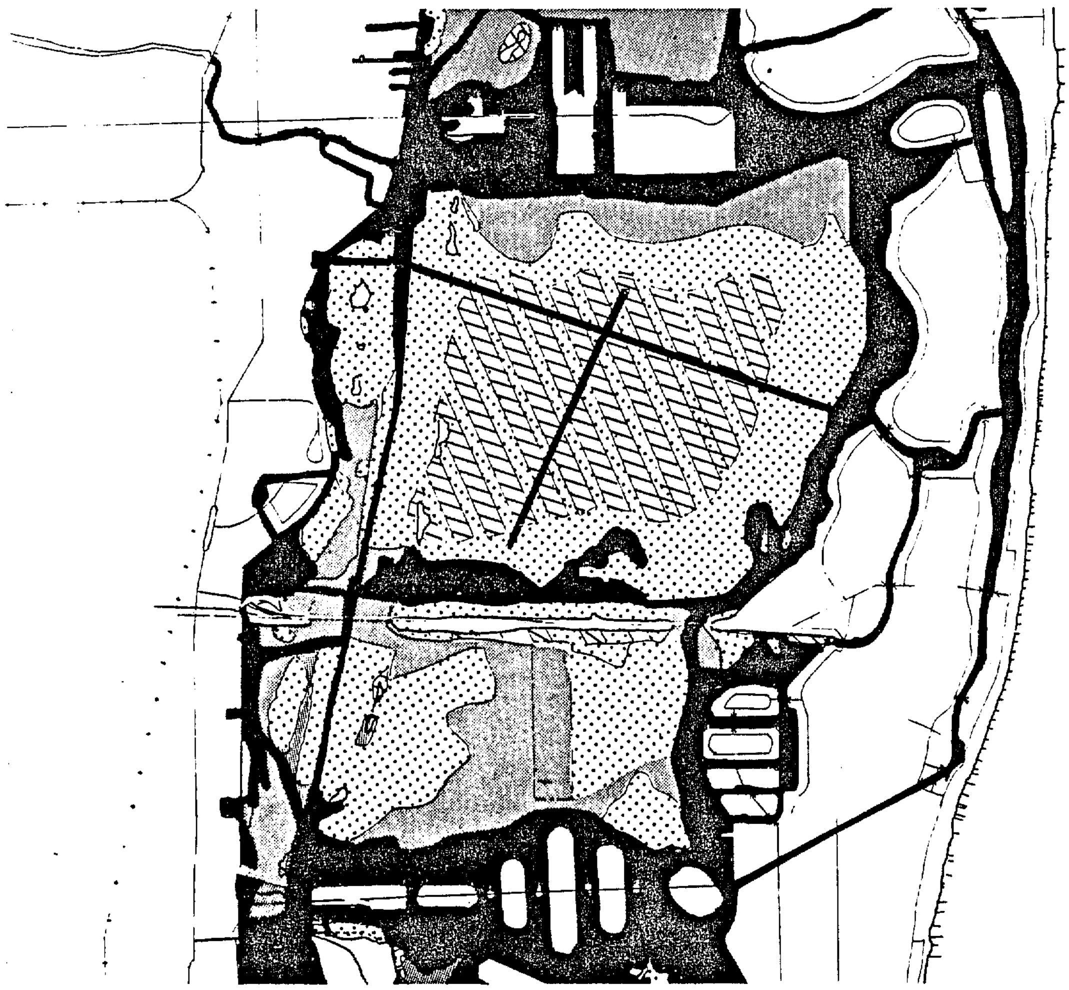


FIGURE 33

NPMA BENTHIC COMMUNITIES

UNITS III-IV

SEAGRASSES
ALGAE/SEAGRASS
BARREN (DREDGED)
BARREN (UNDREDGED)

SOURCE: METRO-DADE DERM (1983c.)

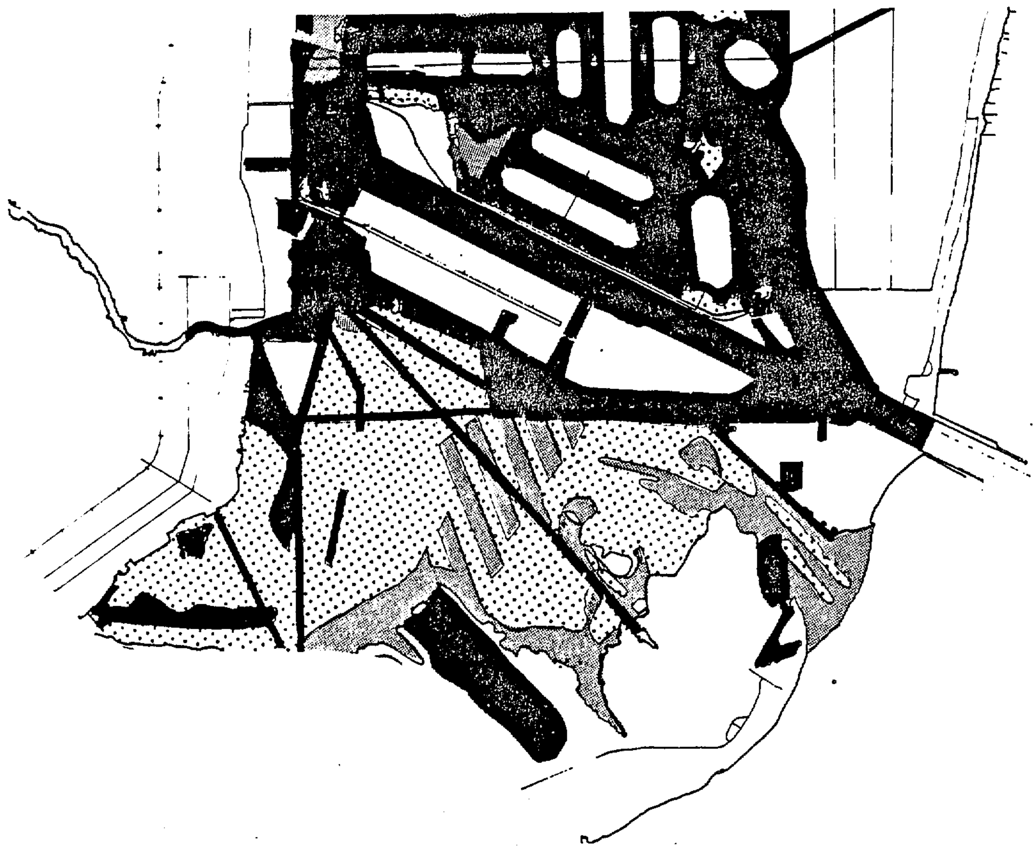


FIGURE 34
NPMA BENTHIC COMMUNITIES
UNITS V-VII

- SEAGRASSES
- ALGAE/SEAGRASS
- BARREN (DREDGED)
- BARREN (UNDREDGED)

SOURCE: METRO-DADE DERM (1983c.)

initial plantings. In 43 percent of the subplots that were planted the degree of survival was rated as a total loss (Connell and Associates, 1983). Of those that survived, Thalassia shoots had the highest rate of survival (63 percent), followed by Halodule shoots (46 percent) and Syringodium (9 percent). Halodule plugs which were planted in six subplots had a 24 percent survival rate (see Figures 35, 36 and 37).

The highest rates of survival were observed in Units III and VI. Poor rates of survival were observed in Units II, VII and VIII. The rate of survival in the 25 acre planting off Mercy Hospital was extremely low. The overall survival rate for Phase I was about 12 percent.

A second phase of planting was done, primarily at a location east of NE 28 Street in Unit IV, which had shown good survival rates in Phase I. At this location 15 acres of Halodule shoots and five acres of Thalassia shoots were planted during the summer of 1984. An additional 1.6 acres were planted in the same general vicinity to mitigate for seagrass beds that were eliminated by construction of the Rickenbacker Causeway and the Homestead Bayfront Marina. About a year later, a 70-80 percent survival was noted for the Thalassia and 30-50 percent survival was observed for the Halodule (Marcus, personal communication).

In the summer of 1985 seagrasses that would have been destroyed by the Key Biscayne Beach Restoration project were planted in 73 acres at the Mercy hospital site. Unlike most of the earlier plantings, which were done using shoots of seagrass, this planting used six inch "plugs" of uprooted seagrasses. The following spring the survival rate was observed to be about 50 percent (Gaby, personal communication). Monitoring during the late summer revealed that the survival rate had actually declined substantially from the rate reported in the spring (DERM, 1986).

BENTHIC ORGANISMS

The benthic communities within the APMA are dynamic. Because of the diversity of environmental conditions within this area, there are highly complex relationships that exist between and among various benthic communities at any given time, making clear delineations in community boundaries very difficult (Evoy, 1978). A high degree of variability is also observed in benthic communities seasonally, spatially and over shorter periods of time. These factors together with the extremely high number of organisms and diversity of different kinds of organisms makes it difficult to make generalizations about benthic communities within the APMA.

Thirty-eight sites within the APMA were sampled twice during the 1981-82 period using a 6 X 6 inch petit ponar dredge and once using a trawl. The plants and animals living on the Bay bottom and within the sediments were sorted and identified. Quarterly sampling was undertaken at twelve sites within the APMA during 1982-83.

Based on the data evaluated, Schroeder (1984) noted a few important general observations. The first is that although altered by human activities, north Bay is not dead. The north Bay stations were only

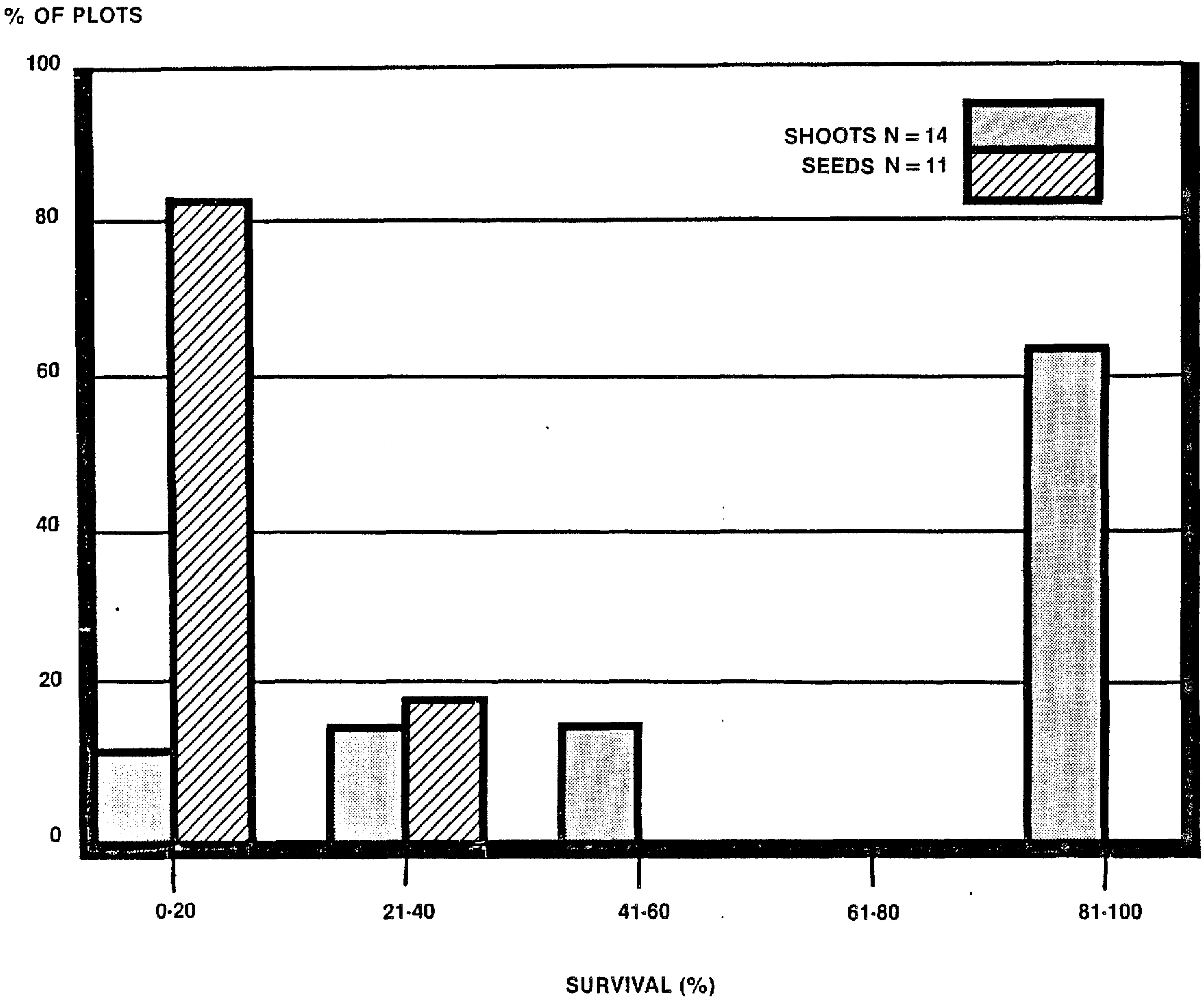


FIGURE 35
***THALASSIA* REVEGETATION SURVIVAL RATES**

SOURCE: CONNELL AND ASSOCIATES, 1983

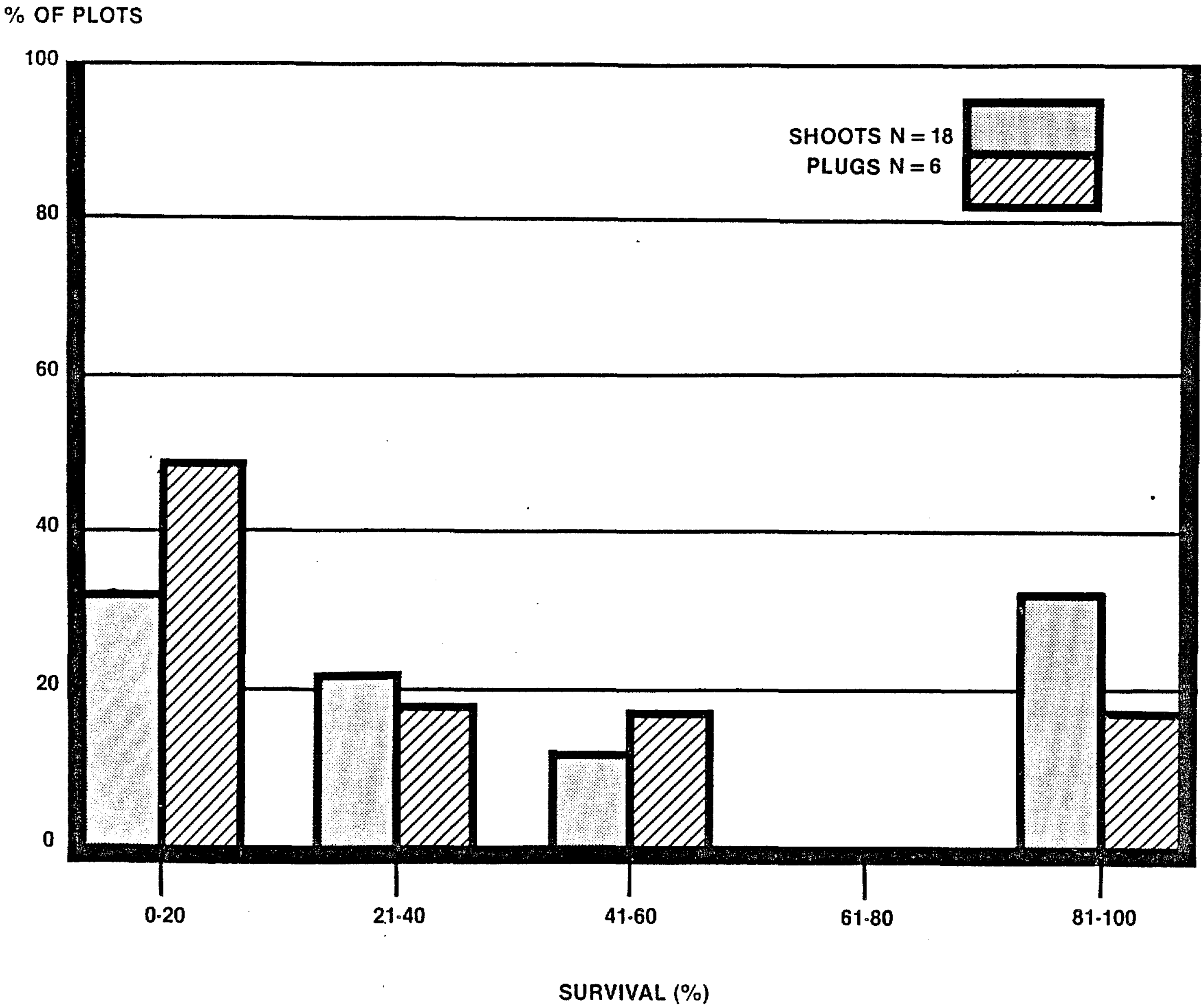


FIGURE 36
HALODULE **REVEGETATION SURVIVAL RATES**

SOURCE: CONNELL AND ASSOCIATES, 1983

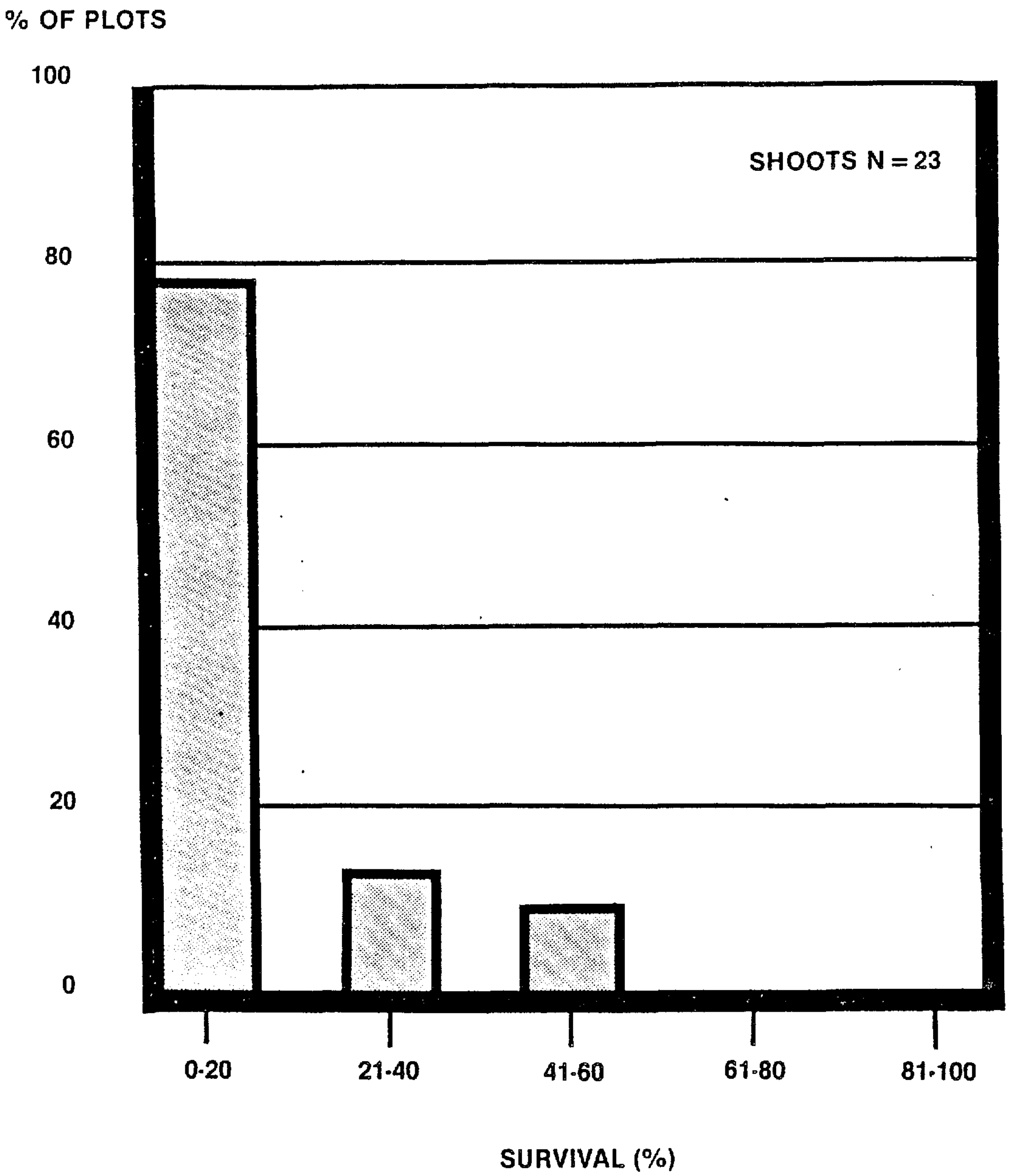


FIGURE 37
SYRINGODIUM **REVEGETATION SURVIVAL RATES**

SOURCE: CONNELL AND ASSOCIATES, 1983

slightly less diverse than south Bay stations in both the wet and dry seasons. He also observed that most types of organisms were found in relatively few stations. Put differently, no one station had many of the total number of different organisms found in the entire Bay system. Schroeder (1984) reported 850 species of benthic organisms and Berkeley (1984) observed over 270 fish species in the Bay.

Large differences in total numbers of benthic animals and numbers of different kinds of animals (diversity) were found during the quarterly sampling between late fall of 1982 and early fall of 1983 (Schroeder, 1984). Most noticeable was a large decline in both numbers of animals and diversity observed in February and March 1983 at the height of the winter dry season. Although observed throughout the Bay, the decreases were most pronounced in areas south of the Rickenbacker Causeway. A partial increase was observed in May 1983. A second decline was observed in August-September 1983. Unlike the winter decline, the hot rainy season decline was most evident in stations in north Bay.

Data on numbers of animals and diversity of animals gathered at the stations sampled from the fall of 1982 to the fall of 1983 were tested for statistical correlations with abiotic factors such as sediment grain size, salinity, dissolved oxygen, water depth, and temperature. Meaningful correlations with grain size, salinity and oxygen were not obtained. However, depth and temperature showed highest correlations during the dry colder season. Most of the correlations with temperature were negative whereas most of the correlations with depth were positive, indicating that perhaps more organisms are limited by the cold than hot weather in Biscayne Bay.

The observed numbers and diversity of benthic animals were also correlated with each of the seagrasses. Some benthic animals were found to be correlated with turtle grass, *Thalassia* during one sampling period but not at others, but few organisms were found to be highly correlated with turtle grass throughout the year long sampling period. More taxa were positively correlated with manatee grass *Syringodium* than with the other seagrasses. Many organisms showed low negative correlation with the seagrass, *Halodule wrightii*. However, as Schroeder (1984) observed, this seagrass is often seen in areas disturbed by wave action and may serve the purpose of stabilizing areas that would otherwise be bare and even more inhospitable to benthic organisms.

The fourth type of seagrass in the APMA is *Halophila*. This flowering plant is usually found at considerable depths or in areas of low water clarity. It often forms a thin, ephemeral cover over muddy bottoms and probably can be used as an indicator of non-ideal conditions. The low negative correlation of many taxa with this seagrass probably reflects the usually low productivity of this habitat. During the May 1983 sampling, a new species of amphipod, a venus clam and two species of polychaete worms were found to be closely correlated with the presence of *Halophila*.

Benthic Communities with High Numbers of Organisms

Of the twelve areas within the APMA sampled during 1982-83, the four most rich were:

1. The area located in the large grass-algal bed north of Julia Tuttle Causeway in Unit III, which has been noted for its water clarity as well as for large numbers of fishes and crustaceans (Berkeley, 1984). Large patches of this area are covered with calcareous macroalgae, Halimeda, and there are thick regions of the seagrass, Syringodium. As observed by Schroeder (1984), this is by far the most productive station observed in terms of numbers of organisms and second only to a station in the Ragged Keys in terms of numbers of different taxa. According to Schroeder (1984), Berkeley (1984) and Wanless, et al (1984), this area represents a management ideal for the urban environment of north Biscayne Bay.

2. The area north of the Rickenbacker Causeway about 500 feet east of the Intracoastal Waterway in Unit VII is covered with thick turtle grass. This area was observed to support both a high number of total organisms as well as large numbers of different taxa.

3. A surprisingly diverse benthic community was observed near the western shore just north of the Julia Tuttle Causeway in Unit III. The bottom in this area has been scoured and is covered by a thin layer of ooze, and the water column was generally observed to be quite murky. The vegetation in this area was observed to be quite unstable with bottom cover of Halophila in varying degrees of density totally replaced by filamentous algae during one sampling period. In spite of these conditions, this area exhibited a high number of organisms as well as high diversity.

4. The area near the western shoreline just south of the mouth of the Biscayne Canal in Unit II was observed to be vegetated with a thick bottom community of mixed seagrasses. This area had a relatively high number of total organisms, but the mean diversity was significantly lower than that observed in the three areas discussed above.

Benthic Communities with Low Numbers of Organisms and Taxa

Of the twelve areas sampled in the APMA from October 1982 to September 1983, four had significantly lower numbers of organisms and taxa than did the remaining sampling areas. It should be noted for purposes of comparison that significantly lower numbers of organisms and taxa were also observed in two other areas, one in Dumfoundling Bay and one at the end of the Turkey Point Channel in far south Bay. The depauperate areas within the APMA were:

1. The area with the lowest overall number of total and different organisms was located on the sandy shore of a spoil island near the Intracoastal Waterway opposite Bakers Haulover inlet, in a shallow area with sparse patches of seagrass and moving sand. This station had the lowest average mean number of organisms and number of taxa of the fifteen stations sampled in Phase II of the study. This area is subjected to alternate currents of seawater from the inlet and Bay water on the outgoing tide. It is also exposed to

considerable wake disturbance from the traffic on the Intracoastal Waterway, boats entering and leaving the inlet, and wind action.

2. The area near the mouth of Snapper Creek in Unit VIII is subjected to extreme changes in salinity and water currents as a result of the water discharge patterns in the canal. This relatively shallow area may also be adversely affected by storms. When first visited in the fall of 1981, this area had a relatively thick cover of seagrass vegetation. However during the remainder of 1981, 1982, and 1983, this station was observed to be bare. This station had one of the lowest diversity indices and a low number of different taxa.

3. The third area was located in the middle of Unit V, south of DiLido Island in a barren, mud bottom area. Relatively low numbers of organisms and different taxa were observed at this station.

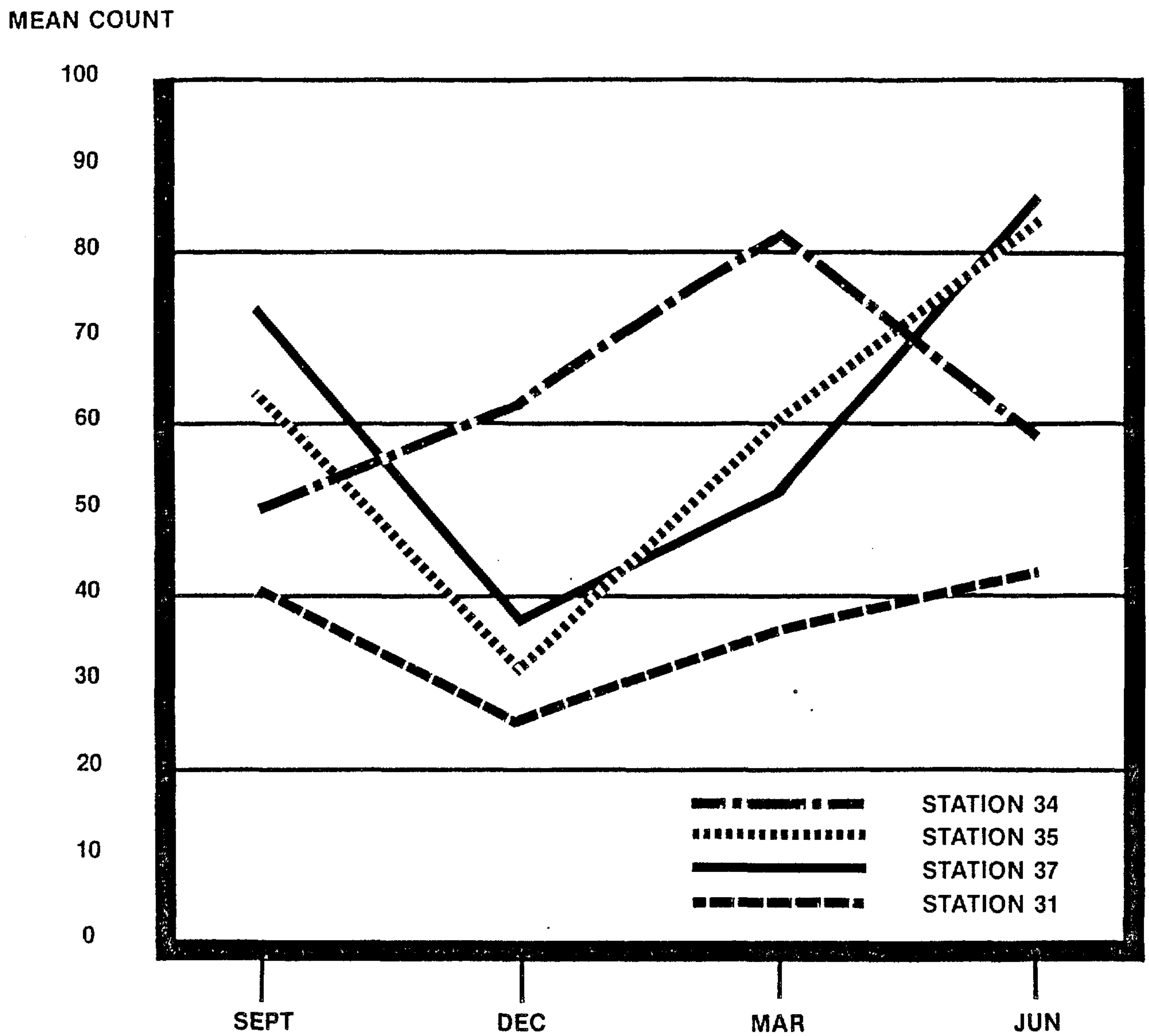
4. The fourth area was west of the ICW almost due east of Chapman Field in relatively deep water, with sparse seagrasses. This area had few, but a somewhat higher mean number of taxa and diversity then the other three stations. Water here was usually clouded with fine calcareous particles. Light probably limited the productivity of this station which may be representative of much of the deeper parts of the lower bay.

As a follow-up on the benthic mapping and sampling programs that have been undertaken in Biscayne Bay, Metro-Dade DERM has initiated a long term monitoring program to establish a quantitative data base and permanent record of abundance of plants and animals which live on the Bay bottom or on the seagrasses. This program will also evaluate the magnitude of seasonal variability in different benthic habitats and complement existing data on water quality, bottom community distribution, and fauna that are found within the sediments. Seven permanent stations within the APMA, plus five in South Bay are being monitored on a quarterly basis. Cursory examination of the year one data reveals maximum seagrass blade and short shoot densities occur during the summer months and minimum values occur during periods of seasonally low temperatures.

In the NPMA seagrass densities varied among sampling intervals, but no significant patterns could be shown. In the CPMA a pattern of higher densities during the winter months and lower densities during the summer months was observed at Station 34 near the mouth of Snapper Creek Canal. In contrast, stations near the middle and the eastern side of Unit VIII had low winter and higher summer mean blade densities (see Figure 38). The densities observed at the Snapper Creek station corroborate the findings of Schroeder (1984), and are probably related to lowered salinities during the wetter summer months. The lowered densities observed at the other three stations probably reflect fluctuations that are related to changes in light and temperature.

MANGROVE COMMUNITIES

In the NPMA mangroves line the mainland shoreline of the the Oleta State Recreation Area and the Oleta River, some of the spoil islands, Bird Key



QUARTERLY OBSERVATIONS
1985-1986

FIGURE 38

***THALASSIA* BLADE BETHNIC MONITORING**

SOURCE: DERM, 1986

and the western shore of Virginia Key and its adjacent islands. In the CPMA, mangroves line the northwestern shore of Key Biscayne and dominate the shore from Matheson Hammock south along the mainland shoreline and along Chicken Key (see Figures 18, 19 and 20).

Mangrove communities provide numerous contributions to the Bay systems. Coastal mangroves bear the brunt of storm tides, protecting the shoreline from severe storm erosion. The extensive prop root system produces a baffling effect which dissipates wave energy and reduces tidal currents. As discussed previously, the mangrove fringe plays an important role in maintaining water clarity, as the maze of roots slows currents and promotes deposition of suspended sediment. Prop roots also provide a surface for the attachment of marine organisms and protection for juvenile fishes from predators. The penetration of the mangrove roots into shoreline mud is basic to the mineral cycling necessary for maintaining the high primary productivity of the marine community.

The export of mangrove detritus, particles of decomposing plant material, is of vital importance to the continued functioning of coastal ecosystems. As fragments of marine grasses and mangrove leaves or twigs drift in the warm shallow coastal waters, they are mechanically broken down and chemically attacked by colonies of bacteria, fungi, or protozoa. The small particles are, in turn, colonized by succeeding micro-organisms; thus the relative concentration of protein and the nutritional value of the particles is enhanced, and they become increasingly more valuable as food sources. The detrital particles, plus associated bacteria, fungi and protozoa are fed upon by detritus feeders (e.g., crustaceans such as amphipods, mysids, copepods, or shrimp and some small or juvenile fish species). The small animals consume the associated bacteria, fungi, and protozoa, and excrete the indigestible cellulose portion, which then becomes substrate for a subsequent assemblage of microorganisms, and the process is repeated.

The detritus feeders are eaten by predators (e.g., carnivorous worms, snails, and numerous juvenile fish), which are, in turn, eaten by larger predators such as snappers, barracuda, sharks, and various marsh and shore birds (e.g., egrets, herons). Each of these higher level consumers contributes waste materials which are acted upon by bacteria and fungi to become part of subsequent detrital food chains.

Mangrove communities constitute dynamic systems that are responsive to natural perturbations. The vigor of mangrove growth is sensitive to alterations in drainage patterns, tidal inundation, overland runoff and water quality. Changes in any of these factors may result in alterations in rates of leaf fall, changes in species distributions or changes in the rates and kinds of exported material to surrounding bays.

The value of mangroves in estuarine systems has been well documented. Therefore, since 1980 mangrove planting has generally been required whenever mangroves have been destroyed as a result of coastal construction activities. Between June 1980 and October 1985 mangrove planting was required as a condition of a number of coastal construction permits. A study of past mangrove planting mitigation projects revealed that most efforts to restore these valuable shoreline communities were unsuccessful due to failure to plant at proper elevations, improper substrate and inadequate protection (DERM, 1983). More recently, however, mangroves have been successfully planted along the Sunny Isles and 79th Street Causeways. A first year survival rate of better than 75 percent has been reported for each area. In both instances, the survival would almost certainly have been higher if people had not driven on, or destroyed some of the plants (Marcus, personal communication).

Recent experiences with pruning of mangrove forests have resulted in County regulations prohibiting cutting or trimming of coastal band red mangroves. In one instance, over 100 mangroves were killed as a result of improper techniques and inadequate monitoring during an experimental pruning study.

FISHERIES

Some of the most important, but least visible wildlife of the bay are the fishes and crustaceans that reside in and migrate through the waters of the Aquatic Preserve Management Area. The Bay is fished both commercially and recreationally with some species sought for food, some for sport, and others for bait. Some of the most important of these include: sport fish such as tarpon, bonefish, snook, and permit; food fish, such as groupers, pompano, snappers, hogfish, mackerels; and crustaceans such as shrimps, spiny lobster, and crabs; and baitfish such as pilchard, ballyhoo, pinfish, mullets, thread herring, Spanish sardines and anchovies.

Biscayne Bay is the home of many commercial fishing vessels. The Bay itself is fished commercially for bait shrimp, blue crabs, stone crabs, mullet, lobster, sponges and "sardines" (Spanish sardine, thread herring, and scaled sardine) (Berkeley, 1984). Sponges are gathered from areas outside of the APMA and will not be included in this discussion. Table 10 outlines the estimated total commercial catch and estimated value from all of Biscayne Bay:

TABLE 10

Estimated Total Commercial Fisheries Catch in Biscayne Bay
(in pounds)

	1982	1983	Approximate Ex-Vessel Value	Approximate Retail Value
Bait Shrimp	287,836	272,573	$4.00/lb	$2,214,657
Mullet	45,000*	44,161**	$0.30/lb	$ 45,000
Stone Crab	43,686	26,991	$3.00/lb	$ 212,031
Blue Crab	---***	42,345	$0.50/lb	$ 42,345
Pilchards[1]	241,000****	241,000	$0.30/lb	$ 241,000
Totals	617,522	627,070		$2,755,033

1 Most are not sold; they are caught and used by the same fishermen
* April 1982-March 1983
** 9 months only, April 1983 - November 1983
*** No estimate for 1982
**** Assuming 30 boats

Source: Berkeley, 1984

NOTE: "The accuracy of these estimates varies by species. We feel that the shrimp estimates are good; mullet estimates represent a minimum catch and almost certainly are an underestimate of actual landings; stone crab and blue crab estimates require assumptions about total effort which are difficult to validate but do not seem unreasonable; pilchard landings seem high but we believe they are reasonable and may actually underestimate actual landings." (Berkeley, 1984)

According to Berkeley (1984), the dockside value of the commercial fishing industry utilizing Biscayne Bay is approximately $1.3 million. At the retail level the commercial catch from the Bay (excluding lobster and sponges) is worth approximately $2.75 million. These figures include only the value of the commercial fisheries, and do not take into account income which is earned from the fishing industry itself or from sportfishing.

According to Berkeley (1984), pink shrimp is the most important species harvested (by weight) in Biscayne Bay, accounting for 29 percent of the total recreational harvest. Gray snapper, white mullet, pilchard (scaled sardine), white grunt, and spotted seatrout are the five most abundant finfish harvested recreationally in the Bay. Together they account for 35.5 percent (by weight) of the total recreational harvest and 51.7 percent of the total recreational finfish harvest (Berkeley, 1984).

In response to concerns over potentially negative impacts of shrimp harvesting on the Bay resources, a study on the impact of commercial fishing on the populations of bait shrimp in Biscayne Bay was undertaken by Campos and Berkeley (1986). They found that the commercial fishery removes only about six percent of the available shrimp each month. This represents approximately 20 percent of the total mortality or loss of shrimp from the Bay system. Natural causes of death such as predation or disease constitute the greatest lost (64 percent), suggesting that most shrimp are utilized by other fish in the Bay for food. Another source of loss is the migration of mature shrimp out of the Bay to Ocean spawning areas. Since only a fraction of the shrimp are removed by commercial fishing, Campos and Berkeley (1986) concluded that the bait shrimp fishery has a relatively small impact on the shrimp population in Biscayne Bay and on the species that depend on shrimp for food.

Some additional questions remain relative to the impact of commercial shrimping on the Bay's resources. One is the amount and impact of juvenile fish mortality resulting from incidental capture in shrimp trawl nets. To evaluate this impact quantitative estimates of juvenile fish populations and their total mortality must be derived.

Based on a 21-month Baywide creel survey of fishermen at boat launching ramps and shore access points during the day and night, Berkeley (1984) found that the mean combined catch for all species was 0.94 fish per hour of fishing in both north and south Bay. However, this does not take into account the "quality" or size of the species caught. Many of the more desirable species were more abundant in south Bay and the mean weight per fish caught in south Bay was 0.42 pounds compared to 0.37 in north Bay (Berkeley, 1984).

The total number of recreational species combined (excluding shrimp and bait fish) caught in the APMA was 60.7 percent of the Baywide catch. When shrimp and bait fish were included in the data, the total catch in the APMA was 97 percent of total Bay catch.

There is very little seasonal variability in either total catch or total effort within the Bay, but the highest catch per hour of fishing was observed during the winter months (Berkeley, 1984). The greatest fishing effort was observed in the areas just south of the Rickenbacker Causeway and just west of Key Biscayne in Unit VIII. The area just west of Key Biscayne also produced the greatest total weight of fish caught in the survey. Of all of the shore access points monitored in this study, the Rickenbacker Causeway and Cape Florida were the most heavily used (Berkeley, 1984).

From April 1982 through September 1983 monthly trawl samples were taken at thirty-five sites throughout the Bay. Eleven of the trawl stations were in NPMA and nine were in the CPMA. At each station three, five minute tows were taken using a pair of roller frame fishing trawls (Berkeley, 1984).

The highest amounts of fish and crustacea biomass were reported for the grass/algal bed north of the Julia Tuttle Causeway in Unit III (see Figure 39). This area had significantly higher numbers of pink shrimp and spotted seatrout and higher average numbers of gulf toadfish and blue grunts than any other Bay stations. Gray snapper, pigfish, pinfish, and silver jennys were also abundant in this area. However, Berkeley (1984) noted that because this area is small (less than four square miles) it's

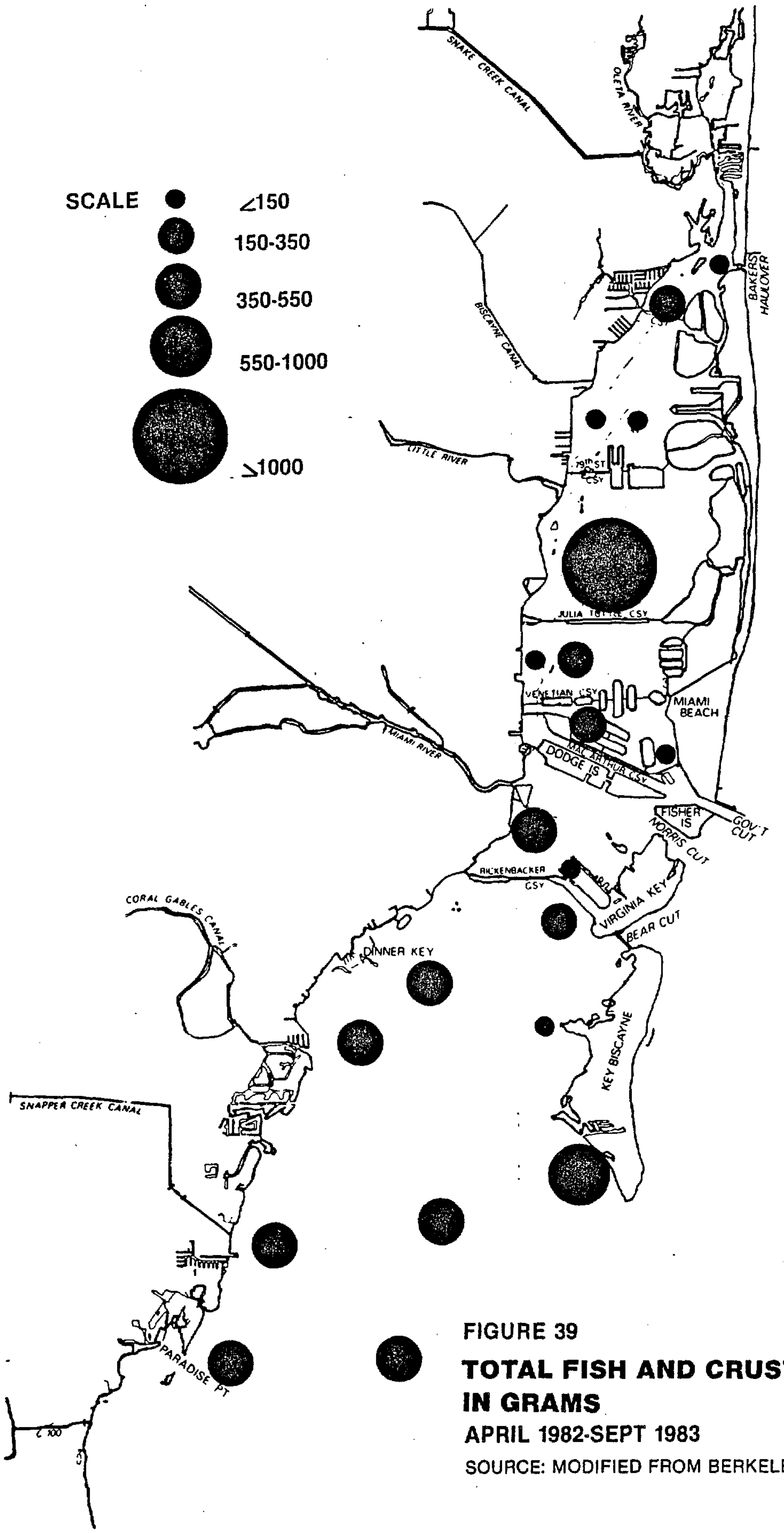


FIGURE 39

TOTAL FISH AND CRUSTACEAN BIOMASS IN GRAMS

APRIL 1982-SEPT 1983

SOURCE: MODIFIED FROM BERKELEY, 1984

total contribution to the Baywide shrimp and fish populations is relatively small.

With the exception of the area south of Brickell Key, which had relatively high numbers of pink shrimp, lobsters, white grunts, and sand perch, and the station south of DiLido Island, where ornate crabs, blue crabs and sand perch were relatively abundant, the other trawl stations in the NPMA had much lower densities of fish or crustaceans than the CPMA or south Bay. The lowest levels of fish and crustacean biomass were observed in Unit I north of Bay Harbor Islands, at two stations in Unit II, on the west side of Unit IV, east of Star Island in Unit V and off West Point in Unit VIII (see Figure 39).

A number of species, including sand perch, silver jenny, and ornate crab showed no significant difference in mean density between north and south Bay. However, blue crabs, spiny lobster, snappers, hogfish, pinfish, grunts, pigfish, and sailor's choice were found to be more abundant in south Bay (Berkeley, 1984).

Based on the trawl and creel surveys, Berkeley (1984) evaluated the diversity, evenness and the richness of the Bay's fisheries. Diversity is a measure of the variety of species in the Bay, taking into account the relative abundance of each species. Evenness is an aspect of diversity and is the degree to which all species are equal in abundance, in contrast to strong dominance by a few species. Richness is a measure of the variety of species in the Bay. Berkeley (1984), found that the richest, most diverse and most even fisheries areas of Biscayne Bay are concentrated in a few locations: the area from the Rickenbacker Causeway south to the old Biscayne National Monument boundary, a large portion of which is within the APMA; the extreme south Bay outside of the APMA; and the grass bed area north of the Julia Tuttle Causeway.

In general, the areas with the highest crustacean biomass were the seagrass beds along the mainland shore, while the mean individual weight of fish was larger at mid and eastern Biscayne Bay. Larger "resident" species such as toadfish, spiny box-fish, and some parrot fish were more abundant in west Bay seagrass beds, as were newly recruited juveniles of certain nonresident species (grunts, some snappers) (Berkeley, 1984).

Berkeley (1984) found that the single most important factor in determining abundance of most juvenile fish is seagrasses. As seagrass density increases, so does the abundance of many fish species.

Hard bottom areas in central and southern Biscayne Bay also support a high diversity of fishes. Certain important species, including hogfish, yellow snapper, and lane snapper, utilize hard bottom communities as nursery areas. These areas require stable salinities and temperatures, and better water circulation and water clarity than seagrass areas (Berkeley 1984).

In terms of fish abundance, dredged and barren bottom communities were found to be the least productive areas in Biscayne Bay. Using trawling gear, 90 percent fewer fish were caught per unit area over dredged barren areas than were taken over seagrass areas.

OTHER WILDLIFE

Geologically south Florida is young, and terrestrial plant and animal colonization has only taken place in the last ten thousand years during periods when the peninsula was exposed, as compared to northern and central Florida which were colonized over 100,000 years ago (Long and Lakela, 1971). Plant and animal colonization into the newly emergent south Florida peninsula came from a number of directions including: tropical America via in part, the Yucatan Peninsula; the West Indian Islands; and from the temperate region of North America. South Florida constitutes a transition zone where temperate and tropical species intermingle. Migration of tropical Caribbean species northward is curtailed both by frost and the lack of suitable tropical habitat, while the subtropical climate and competition curtail the southward colonization of temperate species. Limited numbers of species do, however, bridge these natural barriers.

BIRDS

The avifauna of Biscayne Bay is perhaps the most conspicuous of the Bay's wildlife. Adding to the diversity of the species which are permanent residents of the Bay are other species which migrate through the area and species which winter or summer here. There are particular areas where many migratory species roost (rest) and forage in the Aquatic Preserve area. One is on the tip of Cape Florida, where warblers and raptors roost, and another is the northernmost island of Bird Key in Unit III south of Pelican Harbor, where a variety of shorebird species are seen in the winter months (Cummings, personal communication). Table 11 lists representative bird species of the APMA, the Bay habitats they use for feeding, nesting and roosting, and the time of year they are in the Area.

There are a number of major bird rookeries within the Aquatic Preserve Management Area, including Bird Key and Chicken Key in Unit VIII, where Great Blue Herons as well as other herons and egrets, pelicans, and cormorants nest. One important feature in these nesting areas is the shallowness of the surrounding water. If people can gain access by boat and disturb an area, then the nesting birds may abandon the area. Herons, pelicans, cormorants, and other species can also be seen roosting in some of the mangrove islands in north Bay, in the mangrove shoreline south of Matheson Hammock and in the trees along the shore of Key Biscayne.

Just east of Greynolds Park and north of the Sunny Isles Causeway, there are a number of mangrove islands in an area that is commonly referred to as West Lake.* These islands and the mixed red-white mangrove forests and lakes are a renowned bird rookery (nesting). It is estimated that

*Not to be confused with West Lake in Broward County or West Lake in Everglades National Park.

TABLE 11

REPRESENTATIVE BIRDS OF THE AQUATIC PRESERVE MANAGEMENT AREA

	Habitat/Use			
	Open Waters	Beaches & Flats	Mangroves	Comments
WADING BIRDS				
Herons:				
Great Blue		F	N,R	(p,w)
Great White		F		Color phase of Great Blue; Restricted to South Fla. and the Caribbean; Common on Virginia Key mud flats
Green-backed		F	N,F,R,	(p,w) Formerly called Green Heron
Little Blue		F	N	(p,w)
Tricolored		F	N	(p,w) Formerly called Louisiana
Yellow-Crowned Night-		F	N,R	(p,r) Not common, but regular
Black-Crowned Night-		F	F,R	(w,r) Occasional
Egrets:				
Great		F	R	(p,w)
Snowy		F	R	(p,w)
Cattle		F	R	(p,w) Abundant along causeways, at Virginia Key sewage plant
Reddish		F	R	(p,r) Regular visitor at Va. Key
Ibis:				
White		F	N,R	(p,w)
Glossy				(r) Sometimes seen with white ibis at Va. Key sewage plant
Clapper Rail		F	N,F,R	(p) Feeds in mangrove fringes, rarely in open
Roseate Spoonbill		F	R	(p) Uncommon

KEY: F = Feeding Habitat/ N = Nesting Habitat/ R = Roosting (Resting) Habitat

(r) = Rarely seen, but known to be in the APM Area
(m) = Migrates through the APM Area
(w) = Winters in the APM Area
(s) = Summers in the APM Area
(p) = Permanent residents (Many species that are here year-round are joined by other of the same species for the winter, considerably enlarging the winter population over the permanent population)

NOTE: This list of representative birds of the Aquatic Preserve Management Area was prepared by Bruce D. Neville and A. Morton Cooper, Jr., Board Members of the Tropical Audubon Society.

TABLE 11 (continued)

	Habitat/Use: Open Waters	Beaches, & Flats	Mangroves	Comments
SHOREBIRDS				
Plovers:				
Semipalmated		F,R		(m,w)
Wilson's		F,N	R	(p) Nest on Virginia Key
Black-bellied		F,R		(m,w)
Piping		F		(m)
Killdeer		F,R		(m,w) Most common in sewage plant
Sandpipers:				
Spotted		F,R		(m,w) Sewage plant
Solitary		F,R		(r,m) Sewage plant
Pectoral		F,R		(m) Sewage plant
Least		F,R		(m,w) Sewage plant
Stilt		F,R		(m) Sewage plant
Semipalmated		F,R		(m) Sewage plant
Western		F,R		(m,w) Sewage plant
Yellowlegs:				
Greater		F,R		(m,w) Sewage plant
Lesser		F,R		(m,w) Sewage plant
Ruddy Turnstone		F,R		(w,m,s) Nests in Arctic; Summer birds are not breeding
Common Snipe				(w) Sewage plant
Whimbrel		F		(r,w)
Willet		F,R		(p,m,w)
Red Knot		F		(m,w)
Dunlin		F		(w)
Dowitchers:				
Short-billed		F		(w) Sewage plant
Long-billed				(r,w) Primarily sewage plant
Marbled Godwit		F,R		(r,m,w)
Sanderling		F,R		(m,w)
Black-necked Stilt		N,F,R,		(s) Nests in sewage plant

TABLE 11 (continued)

	Habitat/Use: Open Waters	Habitat/Use: Beaches & Flats	Habitat/Use: Mangroves	Comments
RAPTORS				
Bald Eagle	F		N	(r) One pair attempted nesting in Australian Pines near Va. Key last few years, unsuccessfully Construction on Fisher Island may chase them permanently.
Osprey	F	N,F,R	N,R	(p,w) may have declined in recent years in APM Area
Hawks:				
Red-shouldered		F	N,F,R	
Red-tailed		F		(r)
Broad-winged		F	F,R	(m,w)
Sharp-shinned		F	F,R	(m,w)
Cooper's		F,R		(r,m) May not even feed in Bay area on way south
Turkey Vulture		F	R	(p,w)
Northern Harrier		F		(w)
Peregrine Falcon		F,R		(r,m) Cape Florida is significant migration point
Merlin		F	F,R	(m,w)
American Kestrel		F	F,R	(m,w)
Eastern Screech-Owl		F,N		(p,w) Cape Florida
WATERFOWL*				
Red-breasted Merganser		F	R	(w)
Northern Shoveler		R		(r,w) Rarely also in sewage plant
American Coot	F,R			(m,w) Primarily a freshwater species
Blue-Winged Teal	F	F,R		(m,w)

* Strictly speaking, only ducks, geese and swans are waterfowl

TABLE 11 (continued)

	Habitat/Use			
	Open Waters	Beaches & Flats	Mangroves	Comments
SWIMMING BIRDS				
Brown Pelican	R	R	N,R	(p,w)
Magnificent Frigatebird	F		R	(p,s) Does not rest on water
Double-crested Cormorant	F	R	N,R	(p,w)
Common Loon	F,R			(w)
Gulls:				
Laughing	F,R	N,F,R		(p,w)
Ring-billed	F,R	F,R		(w)
Herring	F,R	F,R		(w)
Great Black-backed	F,R	F,R		(r,w)
Bonaparte's	F,R	F,R		(r,w)
Terns:				
Least	F	N,F,R		(s)
Royal	F	F,R		(p,w)
Forster's	F	F,R		(w)
Caspian	F	F,R		(w)
Sandwich	F	F,R		(w)
Gull-billed	F	F,R		(r)
Common	F	F,R		(r)
Black Skimmer	F	F,R		(w) Feeds in open shallows; does not rest on water
Pied-billed Grebe	F,R			(m,w) Primarily freshwater species but found within APM Area

TABLE 11 (continued)

	Habitat/Use			
	Open Waters	Islands, Beaches & Flats	Mangroves	Comments
PERCHING BIRDS, SONGBIRDS, AND OTHERS				
Warblers:				
Prairie		N,F,R	N,F,R	(p,m,s)
(Cuban) Yellow			N,F	(s) Formerly nested behind Marine Stadium, the northernmost nest of the subspecies
Black-and-white		F	F	(w)
Northern Parula		F	F	(w)
Yellow-rumped		F	F	(w)
Yellow-throated		F	F	(w)
Palm		F		(w)
Common Yellowthroat		F		
Cape May		F		(m)
Black-throated Blue		F		(m)
Blackpoll		F		(m)
Ovenbird		F		(m,w)
Northern Waterthrush		F		(m,w)
American Redstart		F		(m,w)
Black-whiskered Vireo		N,F	N,F	(s)
Belted Kingfisher	F	F,R	F,R	(w)
Mangrove Cuckoo		N,F,R	N,F,R	(r,s)
Red-bellied Woodpecker		N,F,R	F	(p)
Yellow-bellied Sapsucker		F	F,R	(w)
Rock Dove		F		Common pigeon
White-crowned Pigeon		F		(r)
Mourning Dove		F		
Common Ground-dove		F,N		Nests on coastal dune at Cape Fla.

TABLE 11 (continued)

	Habitat/Use			
	Open Waters	Islands, Beaches & Flats	Mangroves	Comments
PERCHING BIRDS, SONGBIRDS AND OTHERS (Continued)				
Yellow-billed Cuckoo		F	F	(s)
Smooth-billed Ani		F		
Common Nighthawk		F		(s) Aerial feeder; Roosts in trees in daytime
Ruby-throated Hummingbird		F		(r)
Pileated Woodpecker		F		(r)
Gray Kingbird		F	F	(s) Nests
Tree Swallow	F	F	F	(w)
Barn Swallow	F	F	F	(m)
Fish Crow		F		
Northern Mockingbird		F		
Thrushes:				
Swainson's		F		(m)
Gray-cheeked		F		(m)
Veery		F		(m)
Blue-gray Gnatcatcher		F	F	(w)
European Starling		F		
White-eyed Vireo		F	F	
House Sparrow		F		
Bobolink		F		(m) Common in Va. Key sewage plant
Red-winged Blackbird		F		
Grackles:				
Boat-tailed		F		
Common		F		
Northern Cardinal		F,N	F,N	
Savannah Sparrow		F		(w)

2,300-2,500 egrets, herons, ibises and cormorants use this rookery. The birds in the Greynolds rookery are known to travel as far north as West Lake in Broward County in search for food (King, personal communication, 1986). Other roosting and nesting species include Common Egrets; Tri-colored, Black-crowned Night, Yellow-crowned Night, Little Blue and Green-backed Herons; cormorants, anhingas and hybrid scarlet ibises. In the summer, Roseate Spoonbill and Brown Pelican juveniles are especially numerous on these islands.

The Oleta River is assumed to be a major feeding area for the birds of the West Lake islands. During low tide, white ibises and various species of herons can be found feeding in the white mangroves along the Oleta River. Ospreys have also become quite numerous in the West Lake/Oleta River areas, although no Osprey nests have been seen in the area (King, personal communication, 1984).

The relationships between rookery sites and feeding or roosting sites are little known. It is likely that birds nesting outside of the APMA use the area for feeding. Locations used for feeding and resting may be less dramatic than nesting sites in terms of the numbers of birds using them simultaneously, but they are extremely important to bird survival. Since many birds selectively utilize differing regions of the coastal zone for feeding, resting and nesting, their life cycles tend to reemphasize the importance of viewing the coastal zone as a whole system, rather than as a series of separate areas.

Wading Birds

Wading birds, including herons, egrets, ibises, and Roseate Spoonbills are all permanent residents of the Aquatic Preserve Management Area. The ibises and spoonbills are found roosting and feeding along the tidal flats and sewage plant ponds on Virginia Key, and on the western side of Key Biscayne in the non-breeding season. While their rookeries are not within the APMA, ibises and spoonbills appear in large numbers during the summer on Virginia Key (Kelley, personal communication). They have also been seen roosting and feeding in the mangroves and tidal creeks of the Chapman Field Area (Evoy, personal communication) where Wood Storks are found foraging seasonally (Owre, personal communication, 1984).

Egrets and herons are some of the most easily noticed birds in the Bay. Herons seize fish with their long beaks and need both clear waters and shallow mud or sand flats relatively close to their nests to fish. As shallow Bay areas are dredged and bulkheaded, wading bird habitat is lost. Riprap does not replace wading birds' feeding grounds (Cummings, personal communication, 1984).

While Cattle Egrets are new to the north Bay area, their numbers and area have increased dramatically over the last 35 years. These birds feed primarily on insects and do not compete for food with the herons and other fish-eating species, but they do compete for nesting sites in the trees. While Cattle Egrets forage inland in pastures and along roadsides, they nest in large numbers in the APMA and their excrement adds nutrients to the area, thereby enriching the Bay environment (Owre, personal communication, 1984).

Shorebirds

Shorebirds are generally short-legged birds that feed at the shoreline using a variety of foraging strategies. Killdeers, plovers, stilts, sanderlings, and sandpipers are found in the intertidal areas along causeways, beaches, sand flats and spoil islands. The plovers are short-legged running birds which obtain their food from the substrate (Owre, 1976). Ruddy Turnstones are a common shorebird species that feeds by overturning stones, shells and seaweed to uncover marine invertebrates, their eggs and larvae (Cummings, personal communication, 1984).

The APMA is a major stopover in the autumn migration of North American shorebirds. These birds, including sanderlings, sandpipers, godwits and knots can be found feeding and roosting in the western Virginia Key area. Some of these birds stay the winter, and a few, including sanderlings are known to sometimes remain through the summer (Kelley, personal communication).

Other Migrating Species

The mangrove fringe and islands of the Bay Preserve area also provide resting, feeding and nesting areas for many migrating species on their way to other areas. Warblers, vireos, tanagers, finches and other species all take advantage of the abundant insects inhabiting the mangroves. Prairie and Yellow Warblers have nested in the mangroves of Virginia Key and are known to remain in the APMA year round (Kelley, personal communication). Swallows, on the other hand, pass by on their way to and from South America and eat insects that fly above the mangroves (Owre, 1976).

Raptors

Raptors, including eagles, ospreys, falcons and hawks can be found in a number of areas roosting in mangroves. Classified as endangered on the Federal List, Bald Eagles are considered a rare sight in the Bay. An eagle's nest has been found within the APMA, and an adult eagle was sighted a number of times in the vicinity of that nest in 1984 (Cummings, personal communication and Neville, personal communication).

The Osprey is a fish-eating raptor which has undergone severe reduction in numbers across the United States. Their numbers, however, have remained relatively stable in south Florida (Owre, 1976). As indicated by their nesting habits in southern Florida (on telephone poles along U.S. 1 in the Keys), these birds appear to have a tolerance for man's presence. An osprey practice nest was found on one of Christo's surrounded spoil islands in April 1983. According to M. Cummings (1984), these birds were not frightened away from the area by any of the activity. The area from the Port of Miami south to the Rickenbacker Causeway is a favorite winter feeding and perching area for Ospreys.

Hawks are also found in the APMA. Virginia Key and Key Biscayne are major stopover points for migrating hawks, falcons, and other raptors. Large numbers of Peregrine Falcons (between 200-500 birds) have been seen passing over the APMA on their way to and back from South America in October and March. A few of these falcons winter in the Everglades National Park area. Hawks, including the Broad-winged, Sharp-shinned, Red-tailed and Cooper's, as well as Merlins and kestrels, also pass through the APMA in October and March. As many as 700 of these birds have been observed passing through in just a couple of hours. Some of the Sharp-shinned Hawks, kestrels and Merlins remain behind and winter in the APMA (Kelley, personal communication). The Red-shouldered Hawk uses the mangrove fringe to forage, roost, and in some areas to nest (Owre, 1976).

Waterfowl

Waterfowl, including coots and ducks, are less numerous in the Bay area in the winter than a few years ago. These are migrants from Canada and the northern United States. Their reduced numbers here are either a reflection of population declines up north or of a change in wintering grounds due to inadequate local foraging or roosting areas. Generally, the ducks and coots eat plants and invertebrates. The mergansers eat fish and invertebrates from the Bay (Cummings, personal communication).

Swimming Birds

Swimming birds include cormorants, loons, pelicans, frigatebirds, skimmers, gulls and terns. The Brown pelican, an endangered species, is found roosting and feeding (diving for fish) throughout the APMA. However, their nests are limited to the southern island of Bird Key in Unit III. These birds only nest where they can be undisturbed, such as in this area protected by shallows. The APMA is also an important wintering area for a large number of Pelicans from as far away as the Carolinas.

Cormorants, which share the same breeding areas as herons, egrets and pelicans, are ubiquitous in the Bay area. They pursue fish and forage underwater for food. The permanent cormorant population increases dramatically in winter when migrants from the north arrive (Cummings, personal communication). It is not unusual in the winter time to see cormorants perched atop pilings, sailboat masts, navigation markers and other man made objects.

Magnificent frigatebirds roost in mangrove fringes and feed by stealing the food obtained by adult herons or cormorants for their young. They also feed on flying fish and other surface marine organisms, and on the young and eggs of other birds within the mangrove fringe (Owre, 1976); frigatebirds can be found wherever cormorants, herons and pelicans nest (Neville, personal communication). Frigatebirds are common in the

Virginia Key area around the Miami Seaquarium's tree-lined shore (Neville, personal communication), and can be seen in the mangrove shoreline at Chapman Field (Evoy, personal communication, 1984).

Least Terns historically used the beaches above the high tide line as well as causeways land fills for nesting. As development encroached on these, the terns used dredged right-of-way areas along causeways, bulldozed sandy areas, new land fills and spoil islands. However, as man has continued to invade even these areas, the terns have begun nesting on graveled rooftops and in some instances nearby asphalt parking lots (Cummings, personal communication). Royal Terns no longer breed in south Florida (Owre, 1976), however they are found roosting on the spoil islands and tidal flats in the APMA.

Scavengers, Laughing, Ring-billed and Herring gulls are abundant in the APMA, and are especially numerous in north Bay in winter time. While not totally dependent on the Bay for their food, these gulls do roost on mud flats and spoil islands in the Bay at night (Owre, 1976).

Skimmers, which are active during twilight and night time hours, feed by flying over water with their lower beaks inserted in the water (Owre, personal communication). They roost on shallow shores and sandbars in the APMA (Cummings, personal communication).

MARINE MAMMALS

Both Bottlenose dolphins and manatees are marine mammals found in the waters and tributaries of Biscayne Bay. Since passage of the Federal "Marine Mammal Protection Act of 1972" it has become illegal to take, injure, annoy, molest, or kill <u>any</u> marine mammal, including the Bottlenose dolphin, and manatees.

BOTTLENOSE DOLPHIN

Bottlenose dolphin are found in the open waters of Biscayne Bay where they feed predominately on mullet. While there is no past or current data base detailing the exact numbers of dolphins in the Bay, according to Odell (personal communication), their numbers have drastically declined. This decline may in part be attributed to activities in the late 1950's and early 1960's which included the overfishing especially of juvenile females. Those captured were removed from the Bay for display purposes in oceanariums (Odell, personal communication). Environmental changes may also have attributed to the dolphins' reduction in numbers.

MANATEES (SEA COW)

Manatees, an endangered species, are found in the open waters and tributaries of Biscayne Bay. Although lists of manatee sightings have been compiled and aerial counts have been done, data on exact numbers of this elusive species have not been determined. It is estimated that at least 1,000 manatees inhabit Florida's coastal waters, with perhaps as many as 100 residing in Biscayne Bay and its tributaries (Odell, personal communication, 1984).

The number of manatees within Biscayne Bay probably increases in winter, however this seasonal immigration has probably declined in the last 50 years since power plants that discharge warm water effluent in winter have been built in coastal areas around the State. As these power plants are shut down, or put on cold standby for peak uses only, the manatees are expected to once again migrate into the shallow subtropical Biscayne Bay area in larger numbers (Odell, personal communication). This immigration will have implications regarding management of manatee habitat and feeding areas.

Biscayne Bay north of Key Biscayne and all adjoining water bodies north to and including Maule Lake are designated critical habitat for the Florida Manatee by the U.S. Fish and Wildlife Service. However, the only manatee sanctuary in Biscayne Bay, approved by the Governor and Cabinet in 1983, is in Black Creek outside the Aquatic Preserve Management Area.

Studies on manatees within the Bay area suggest that in the daytime, manatees are generally found in the canals where they find protection from boats, and may feed on hydrilla near the salinity dams and algae on pilings. At night they feed primarily on seagrass beds in the open Bay in waters over one meter deep. Manatees will also feed on uprooted seagrass and mangrove leaves. Because of this diurnal behavioral pattern of moving up the canals during the daytime for protection and grazing in open Bay waters at night, the manatees' biggest threat in Biscayne Bay is seagrass habitat loss (Odell, personal communication, 1984).

Generally speaking, healthy adult manatees have no natural predators, however, these creatures do not have any defenses against motorboats. On the average one manatee per year is killed by boats in the Biscayne Bay area (Odell, personal communication). Large boats, yachts tugs and commercial fishing boats are primarily responsible for killing manatees. Small boats with outboard engines are more likely to scar these animals with their props, but not to kill them.

An increase in the numbers of marinas and boats on Biscayne Bay and its tributaries will not only increase the chance of hitting, injuring, harassing and perhaps killing manatees, but may also create increased turbidity which destroys the seagrass beds needed to sustain these mammals (Odell, personal communication). Also, while the manatees in this area have apparently learned to avoid the high traffic boat areas in the daytime and to graze at night in the Bay for food, those animals which immigrate are not accustomed to these diurnal behavior patterns and therefore manatee mortality is expected to increase in the Biscayne Bay area (Odell, personal communication, 1984).

PART IV

UTILITY OF THE BISCAYNE BAY AQUATIC PRESERVE

The Biscayne Bay Aquatic Preserve Management Area has been described in terms of its history, physical and chemical characteristics, and living resources. Another important factor, and one that is addressed both in the enabling legislation (§258.397 F.S.) and the Preserve Rules (16Q-18 F.A.C.), is the utility of the Preserve. In the Rules, utility of Preserve is defined as the "fitness of the Preserve for the present and future enjoyment of its biological and aesthetic values in an essentially natural condition." In the discussion that follows the word "utility" is used in the more conventional sense as "the condition or quality of being useful." While the use and users of the Preserve's diverse resources are important in terms of managing the APMA, they are only empirically understood. There are no hard data on the number of user groups, their preferences and needs, or their quantitative and cumulative effects on this natural resource. A user survey would assist in obtaining quantifiable data. In the absence of a survey, it is estimated that the following groups include approximately 3 million potential Preserve users per year.

- The 1984 population estimates based on 1980 census data revealed that 227,023 residents live within census tracts which border the Preserve. Generally speaking, this population lives within walking distance of the Preserve shoreline.

- A 1980 survey of visitors conducted by the Dade County Department of Tourism indicated that 2,694,127, or 26.1 percent of all the domestic tourists who visited Dade County expressed interest in water sports, boating and fishing. Nine and one-half percent of the international visitors also indicated an interest in these water related activities.

- A third undefined group of potential Preserve users includes the thousands of Dade County residents and tourists who work or shop within walking distance of the Preserve.

- A fourth group consists of citizens from all areas of south Florida who use the Bay and shoreline for active and passive recreation. Although the exact number of people who use the Bay and shoreline actively or passively is unknown, observation of any Bay access point on a weekend when the weather is good, shows that this is a very large group of people.

The ability of any Dade County or South Florida citizen or tourist to see, reach and use the waters of the Preserve depends on several things including: shoreline land uses, the siting of water dependent facilities, programming in shoreline parks, and landscaping and siting of shoreline access points. Each of these may be used to promote or to inhibit public access to, and use of, the Preserve.

SHORELINE USES

The immediate shoreline land use is one of the most critical factors influencing access to and, utility of, the Aquatic Preserve Management Area. The vast majority of the developed Preserve shoreline is developed residentially which effectively limits public access to the Preserve along substantial portions of the shore. The configuration of typical single family neighborhoods, as well as the higher density medium and high-rise residential development, wall off the the Bay, preventing public access to the water, both physically and visually. Inappropriate ancillary uses associated with medium and high density residential shoreline land uses, including parking lots, fenced in swimming pools and tennis courts, and trash collection areas, proliferate along the edge of the Preserve. Both the man-made structures and these various inappropriate shoreline uses fail to complement the natural beauty of the Bay and also create an impenetrable barrier that eliminates access not only from the immediate neighborhood, but from a much larger surrounding area as well. In a number of locations along the edge of the Preserve, the structures that have been built even obscure the water's edge from their own residents. In some condominium developments residents are prohibited from using associated docks and piers for visual or physical access if they do not rent or own a boat slip. In only a very small number of residential developments are walkways and shoreline amenities provided.

The Biscayne Bay Aquatic Preserve Management Area differs from other urbanized shoreline areas in two important ways. The first is that Biscayne Bay in not characterized by a heavily industrialized shoreline with decaying wharf and warehouse districts, which have been condemned, leveled and used to construct water-oriented developments in other urban waterfront locations. Secondly, except for the new Bayside development, and in comparison to other urban shoreline areas, there are comparatively few marine-related shoreline facilities. The few restaurants, bait and tackle shops, and other businesses that provide transient dockage comprise the very limited extent of this area's water-related uses.

PUBLIC ACCESS TO THE PRESERVE

In general, the causeways, parks, spoil islands, and a small number of undeveloped shoreline parcels and street ends provide the general public with the majority of their physical and visual access to the Preserve shoreline.

Causeways

The seven causeways that cross the Preserve provide spectacular views of the Bay for people traveling by vehicular transportation. Except for the Rickenbacker Causeway, however, physical access to the Bay from these roads is either prohibited and/or dangerous. Fishing and shrimping from Causeway bridges and catwalks are commonplace, traditional activities that have been going on since these Causeways were constructed; even though stopping and parking restrictions tend to limit use along some causeways. The potential for additional public physical and stationary visual access from some of the other causeways, as is currently available from the Rickenbacker Causeway, is phenomenal.

Parks

There are more than 30 public parks along the shores of the Aquatic Preserve (Figure 40). Twenty-one of these parks treat the Bay passively; they are inwardly oriented; they do not provide facilities for, or encourage activities that include direct use of the water; they just happen to be located along the shore where park users might, by chance, view the Bay. In some of these passive parks the waterfront is even treated as a hazard, with landscaping that blocks the water's edge and signs prohibiting activities such as fishing and swimming. There is one park located along the Bayshore that does not even afford visual access of the Preserve to its users.

There are fifteen water-oriented parks which provide the general public with facilities for physical and visual access to the Preserve. Two parks have fishing piers adjacent to recently constructed artificial reefs. Nine parks have public boat ramps, although these are not evenly distributed throughout the Preserve area. Three parks within the Preserve contain large, commercial - type marina facilities, but these heavily utilized facilities are all located within the Central Preserve Management Area. Miamarina, located in Bayfront Park, was closed in 1986 but is expected to be reopened when the Bayside project is completed in early 1987. These public, water-oriented parks provide a substantial portion of physical and visual access to the shoreline and to the Preserve itself for those who do not live directly on the shore.

Spoil Islands

Sixteen spoil islands were created by the U.S. Army Corps of Engineers (COE) when the ICW was dredged through north Biscayne Bay. Only twelve of the islands remain in public ownership, but the U.S. Army Corps of Engineers maintains perpetual spoil easements on all sixteen islands and designated areas adjacent to the islands (see Figure 41). This gives the COE the right to place dredged material from the ICW back on the islands and adjacent easement areas at any time. These perpetual easements have discouraged any improvements (i.e. piers, walkways, bathrooms, etc) from being made on the islands in the past.

Although limited to the boating public, the sixteen spoil islands provide a widely utilized public area within the Preserve. The placement of trash cans and the monthly (and summertime bimonthly) trash pickup from eleven of the islands by Metro-Dade have improved the appearance of some of the islands. Thousands of people use these islands annually. Swimming, water skiing and snorkeling take place along the lee sides of the islands; and picnicking and camping takes place along the upland portions. Access to these ad hoc recreational areas could be increased substantially for the general, non boat-owning public if boat rental facilities were provided in shoreline parks.

Street Ends and Vacant Lots

Existing street configurations along the shoreline tend to limit access to the Preserve. Roadways paralleling the Preserve shoreline, where views of the Bay are available, are rare. While there are many small side streets which dead-end at the water's edge, limited parking, guard

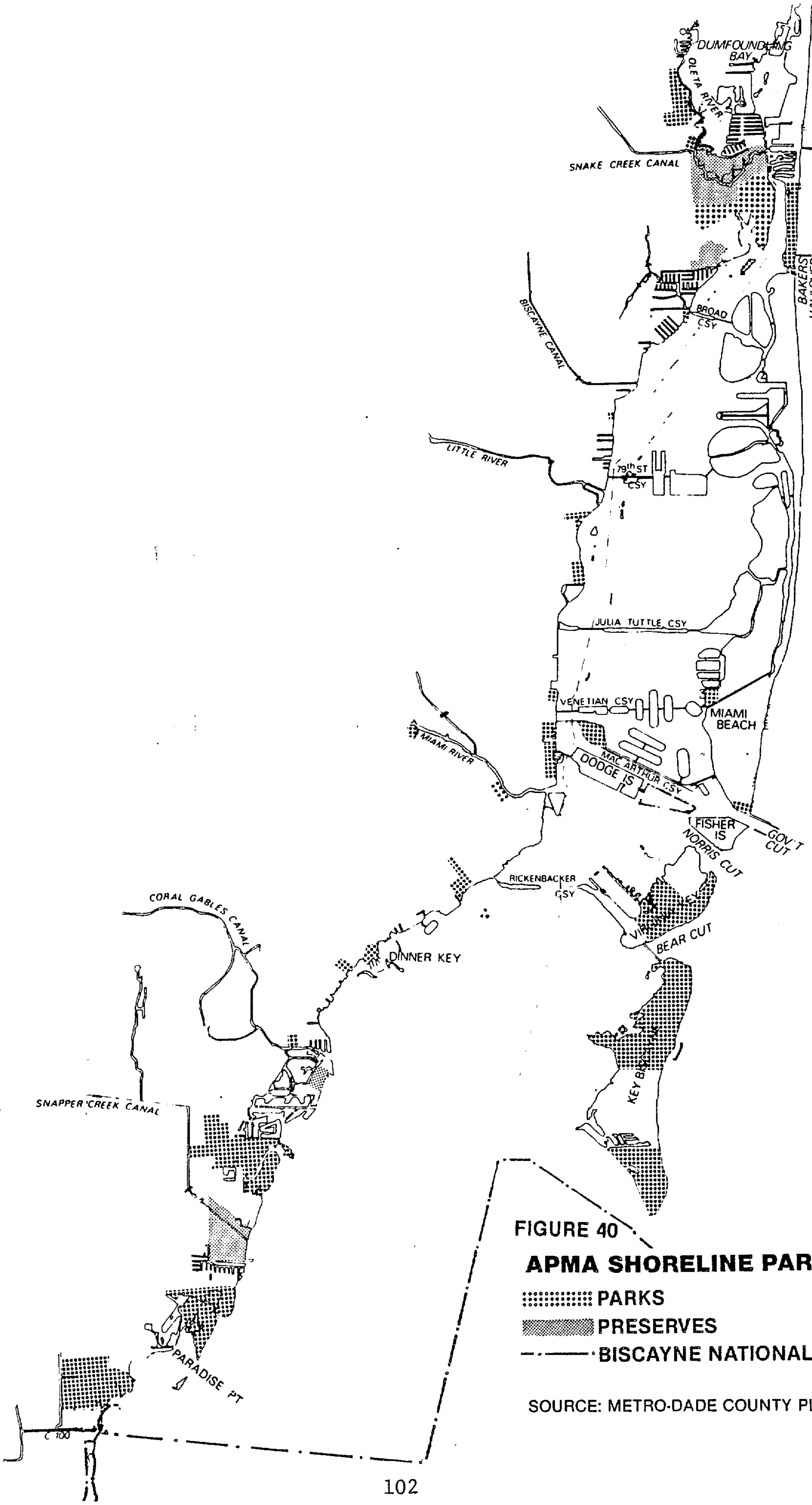


FIGURE 40

APMA SHORELINE PARKS

PARKS

PRESERVES

BISCAYNE NATIONAL PARK BOUNDARY

SOURCE: METRO-DADE COUNTY PLANNING DEPT., 1986

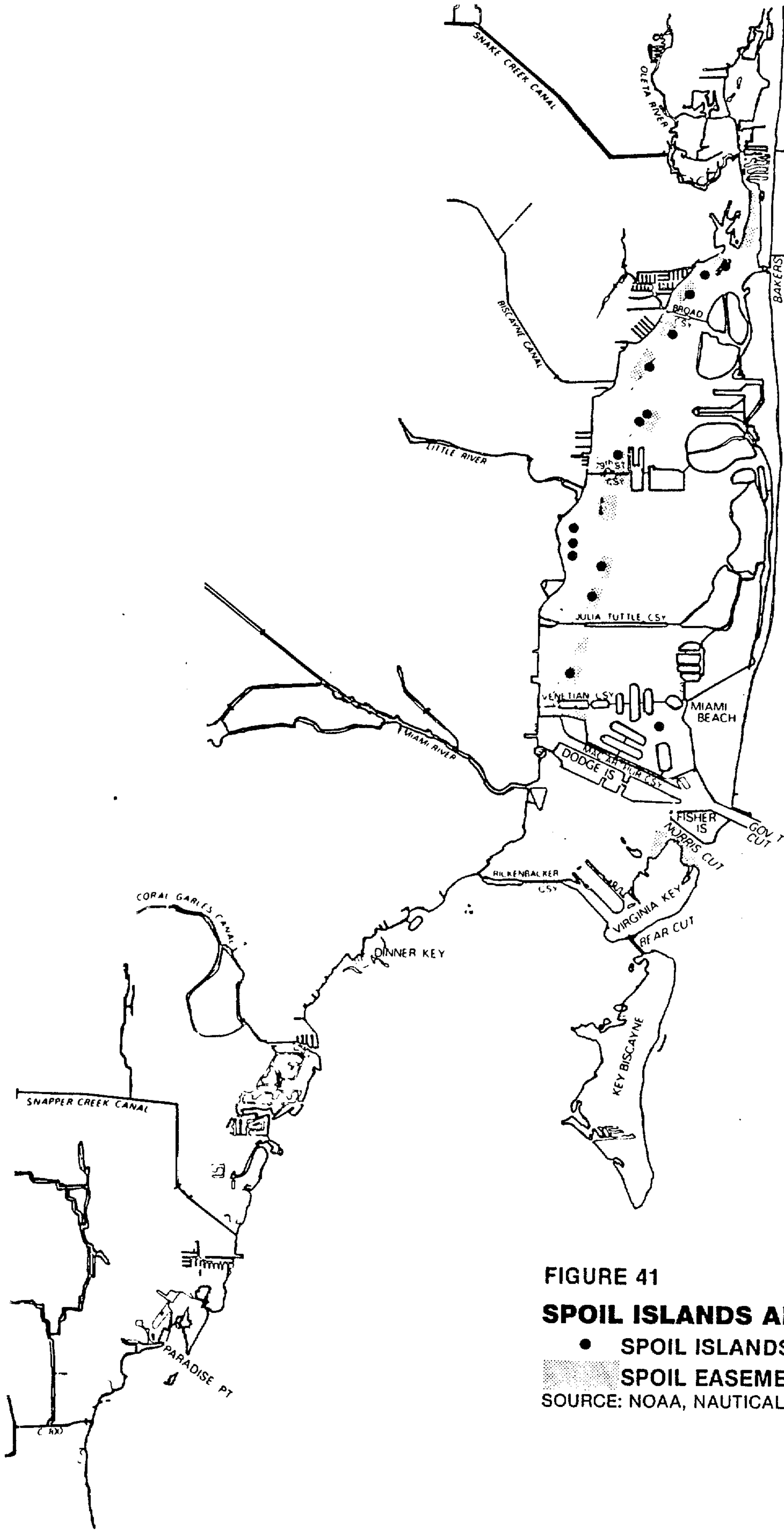


FIGURE 41

SPOIL ISLANDS AND EASEMENTS

- • SPOIL ISLANDS
- SPOIL EASEMENT AREAS

SOURCE: NOAA, NAUTICAL CHART 11467, 1980

rails, trash, and an unkempt appearance, generally discourages their use as Bay access points. These dead-end streets which penetrate neighborhoods to the Bayshore remain relatively unknown to the general public. However, these sites are used by people from surrounding neighborhoods and a number of these sites provide public visual and physical access to the Preserve for members of the general public (see Figure 42).

WATER-DEPENDENT USES

The Preserve shoreline provides space for the various water dependent uses including boat storage, repair and building, fish houses, and marine salvage, towing and construction, which enhance the utility of the Preserve. The fish houses, marine salvage, towing and construction, and boat builders are concentrated along the shores of the Miami River. These will be discussed in detail in Chapter 10. Boat repair facilities are located along the shores of the Miami, Little and Oleta Rivers, and in the Coconut Grove/Dinner Key area. In contrast, public and private boat storage/marina facilities are scattered throughout the entire Preserve area.

In general, the vast majority of the marinas within the Aquatic Preserve Management Area are small to medium sized (10-40 slips) and privately owned and operated. More than half are associated with adjacent upland residential development. Commercial marinas, on the other hand, are generally larger (50 - 100 + slips), and are concentrated in the Oleta, Little and Miami Rivers, and Dinner Key area. A number of private clubs also line the Aquatic Preserve shore. Three large publicly owned and operated commercial-type marina facilities are located in parks along the Central Preserve Management Area.

MARINAS

In order to update a marina inventory done by the Florida Marina Patrol in 1983, facilities with 10 or more slips were re-inventoried using 1986 aerial photos and follow-up phone surveys. As of August 1986, there were a total of 119 marinas Baywide (see table 12). Forty-three were privately-owned and operated commercial facilities, 10 were publicly owned facilities, 14 were associated with private clubs and 52 were private facilities associated with multifamily residential developments. These marinas contained 5955+ wet slips and 3505+ dry slips, for a total of 9,460+ marina berths available Baywide in 1986 (Metro-Dade Planning Department, 1986).

In Units I - VIII of the APMA, excluding the Miami River, there were a total of 75 marinas/boat storage facilities. Of these, 16 were commercial marinas that were privately owned and operated, seven were publicly owned and operated, nine were private clubs and 43 were private facilities associated with multifamily residential developments. These 75 Bayshore facilities contained almost 4,100 wet slips and more than 1860 dry slips (Metro-Dade Planning Department, 1986).

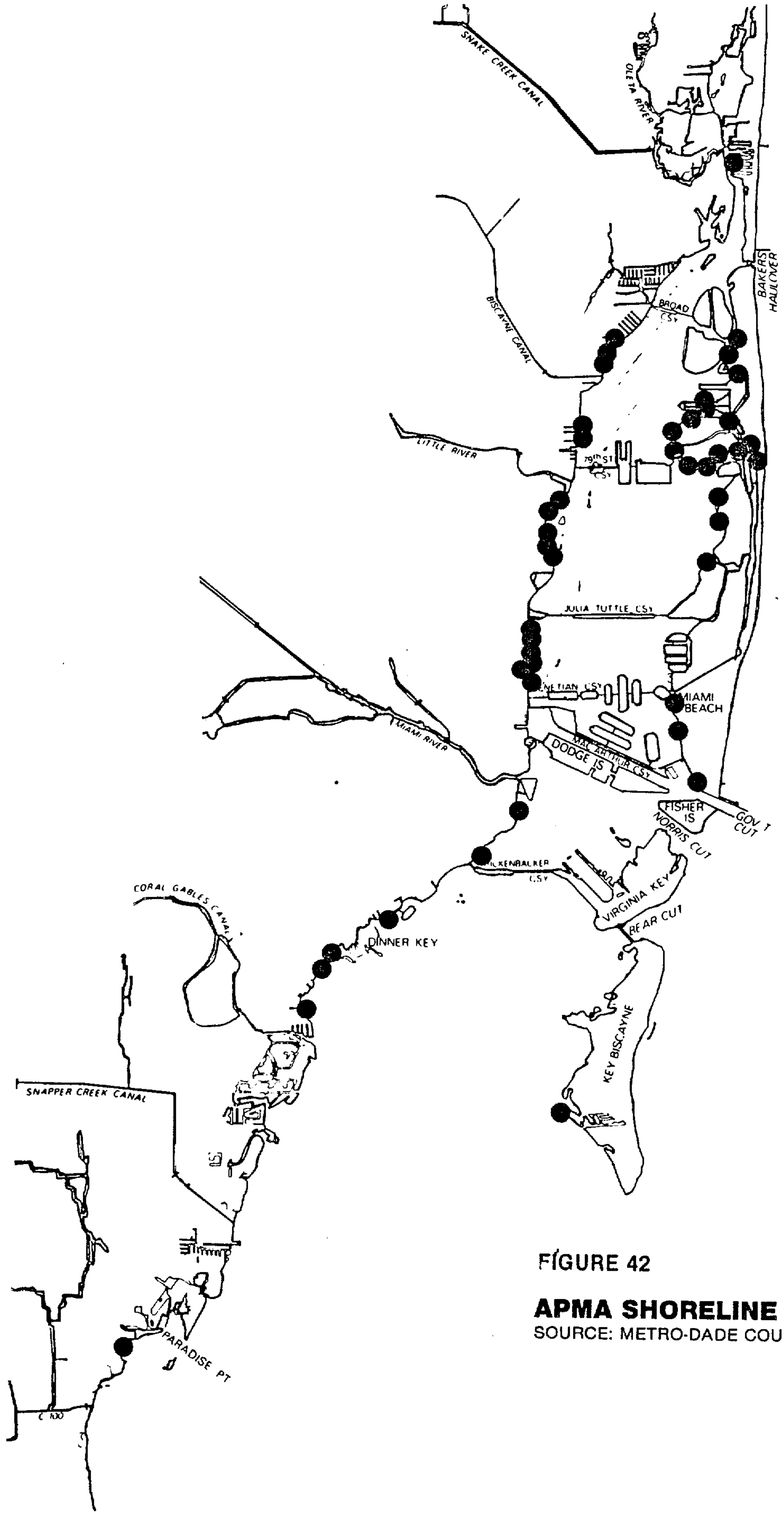


FIGURE 42

APMA SHORELINE STREET ENDS

SOURCE: METRO-DADE COUNTY PLANNING DEPT.

TABLE 12

NUMBER OF FACILITIES AND WET SLIPS, MOORINGS, DRY RACKS AND SURFACE STORAGE SPACES IN BISCAYNE BAY
1986

	WITHIN APMA	OUTSIDE APMA (North)	OUTSIDE APMA (South)	BAYWIDE
MARINA TYPE				
COMMERCIAL				
# of facilities	37	5	1	43
# of wet slips	1988+	100	12	2100+
# of dry spaces	1807	875	60	2742
PUBLICLY OWNED				
# of facilities	7	0	3	10
# of wet slips/ moorings	1000	0	351	1351
# of dry spaces	160+	0	62	222+
PRIVATE CLUBS				
# of facilities	9	0	5	14
# of wet slips/ moorings	681	0	388	1069
# of dry spaces	389+	0	140	529+
PRIVATE ASSOC. W/ RESIDENTIAL				
# of facilities	45	7	0	52
# of wet slips	1179	256	0	1435
# of dry slips	12	0	0	12
TOTALS				
# of facilities	98	12	9	119
# of wet/slips/ mooring	4848	356	751	5955
# of dry spaces	2368+	875+	262	3505+
# of slips TOTAL	7216+	1231+	1013	9460

Source: Metro-Dade Planning Department, 1986.

Along the Miami River there were two marina facilities associated with private residential developments with a total of 78 wet slips; and 21 commercial marina facilities that contained at least 680 wet slips and 240 dry slips. There were also 768 vessels less than 100' in length docked at bulkheads along the River, but these were not included in the marina inventory statistics.

In the entire Aquatic Preserve Management Area the total number of marinas (with over 10 slips) was 98 facilities. These facilities contained 4,848 wet slips and 2,368+ dry slips in 1986 (Metro-Dade Planning Department). The characteristics of these facilities were as follows:

- Thirty-seven commercial facilities supplied 41 percent of the wet slips and 76 percent of all dry slips within the APMA

- The seven publicly owned and operated facilities supplied 21 percent of all wet slips and 7 percent of dry slips.

- Nine private clubs supplied 14 percent of wet and 16 percent of dry slips.

- The forty-five private marinas associated with residential developments supplied 24 percent off all wet slips and less than one percent of dry slips.

The wet slip occupancy rates were estimated for the 75 marinas within the APMA (see Table 13). Occupancy rates for the Miami River marinas could not be determined since many of the River marinas are covered facilities and obscured from viewing on photos). In all cases a factor of 10 percent was added to the actual number of boats counted in order to account for vessels that may have been out of the facility when the aerials were flown.

The publicly owned facilities had the highest total occupancy rate of 97 percent. The private clubs followed with an 87 percent occupancy rate and commercial marinas had a total of 76 percent occupancy. The facilities associated with private residential developments had an occupancy rate of only 45 percent (Metro-Dade Planning Department, 1986). Overall, marinas in the APMA (excluding the Miami River) had an average occupancy rate of 75 percent.

Marina Supply and Demand

In order for the State of Florida to respond to increasing marina siting pressures, the Department of Natural Resources (DNR) contracted with Dr. Bell of the F.S.U. economics department for a marina supply and demand study in 1981. The study used three sources to estimate the supply and demand of wet and dry slips for 1982, including: actual 1982 pleasure boat registrations; a survey mailed to all marinas in the State's inventory to ascertain the supply of wet and dry slips; and, a separate survey mailed to a random sample of people with registered boats to obtain an estimate of marina demand (DNR, 1984).

TABLE 13

WET SLIPS AVAILABLE AND OCCUPIED IN MARINA FACILITIES
WITHIN THE APMA*
1986

Marina Type	# of wet slips Available	# of wet slips Occupied[a]	% Occupied
Commercial (16)[b]	1,308	998	76.3
Publicly Owned (7)	1000	967	96.7
Private Clubs (9)	681	592	87.0
Private-Associated (43) with Residential Development	1,101	492	44.7
TOTALS: All Facilities (75)	4,090	3,049	74.5

*Units I - VIII, excluding the Miami River; in facilities with 10 or more slips

[a]Number occupied plus 10% added as factor for boats out of the facilities
[b](Number of facilities)

Source: Metro-Dade Planning Department, 1986.

In addition to the 1982 supply and demand estimates, projected boat registrations to the year 2005 were ascertained; and projected probabilities for using marina services were used to project future demand for slips for each county. For Dade County the demand for marina slips from 1985 to the year 2005 was expected to increase at an estimated rate of 27 percent or 2,356 slips (DNR, 1984).

As discussed above, there was a Baywide total of 9,460+ wet and dry slips in 1986 (Metro-Dade Planning Department, 1986). It was also determined that the average Baywide wet slip occupancy rate was 75 percent during the first quarter of 1986; of the 5,955 wet slips available 1,489 were vacant (Metro-Dade Planning Department, 1986).

The reopening of Miamarina, phase II of Black Point and Homestead Bayfront marinas, and the expansion of Dinner Key and Pelican Harbor Marinas will add 898 wet and 300 dry slips to the Bay area's supply. The 1,489 vacant wet slips plus the 1,198 slips that are projected to come on line could exceed the State's estimated demand for 2,356 additional wet slips (DNR, 1984) from 1985 to the year 2005. A large percentage of the slips that were vacant in the first quarter of 1986 may not be used due to poor location and design or pricing policies that make them effectively unavailable to the general public, however, the projects that are scheduled to be built will satisfy more than half the demand estimated for the year 2005.

IN-WATER USES

It can be seen from the preceding discussion that all uses of the shoreline affect the quality and utility of the Preserve in some way. The quality of the Preserve is affected most directly by storm water and direct overland runoff and by the configuration and treatment of the shoreline. The utility of the Preserve, for the public at large, is directly related to the degree to which shoreline uses, individually and cumulatively, encourage or limit visual and physical access to the water. The relationships between in-water uses and the quality and utility of the Preserve are even more complex than the relationships outlined above. In-water uses generally occur in specific parts of the Preserve because of existing conditions and accessibility. However, the uses themselves can become limiting factors if they conflict with other uses, if they become so numerous as to bring about a decrease in the enjoyment that is derived from the use, or if the use brings about a decline in the quality of the Preserve.

Biscayne Bay's beauty and utility invites a diversity of recreational and commercial in-water activities, including power boating, sailboating, catamaraning, canoeing, sculling, water skiing, jet skiing, hang gliding, swimming, windsurfing, snorkeling, diving, and fishing. The location of these activities is directly dependent upon the individual basin characteristics. Therefore, these activities will be discussed in detail in the individual unit chapters. There are, however, a number of other in-water and submerged bottom uses such as channels, bridges, pilings and utility crossings that also affect the utility of the Preserve.

The ICW extends in a south and south westerly direction along the western side of the North Aquatic Preserve Management Area providing a direct "roadway" through the Preserve. This channel was dredged by the COE and is lined with lighted and/or reflective markers on pilings. Along the eastern side of the North Preserve Management Area is the Meloy Channel, the borrow area from which the fill was taken to create Miami Beach and many in-Bay islands. Beginning in Unit II, this marked channel hugs the Miami Beach Shoreline. These two channels provide adequate depths for north/south navigation. Unmarked borrow areas paralleling a number of the Causeways also provide deep east/west channels across the Bay. Both publicly and privately dredged channels leading from shoreline areas to the ICW have been delineated by reflective markers on pilings. The entrances to a number of channels are lighted.

Along with the myriad of navigation, bridge, pier and dock pilings, many old submerged pilings and pipes dot the Bay. Many are no longer used and most are shown on navigation charts. One example just south of the Julia Turtle Causeway are the "Pelican Island" pilings - a concrete and rebar remnant of an unfinished chain of mid Bay islands.

Permits for private signs on pilings in the Bay have not been granted by DERM since 1980. However, two private signs remain directing boats to marinas at the Jockey Club in Unit II and the Palm Bay Club in Unit III.

Just offshore of the mainland in Unit V, there is a radio tower located in and over the waters of the Aquatic Preserve. In the past, this tower was used to transmit and receive radio signals at the Miami Herald and Miami News. In the late 1970's a permit to place a radio tower in the lush grass beds of Unit III was denied and the tower placed on an upland location.

A seaplane operating area is designated on navigation charts in the Central portion of Unit VIII (see Figure 43). There are also two additional locations in north Bay that have been traditional seaplane operating areas. In Unit V, the area just west of Hibiscus and Palm Islands is used by private seaplanes. The number of seaplane ramps along these residential islands is testament to this traditional use. The commercial Chalks airline located on the south side of Watson Island has used the FEC slip and the Miami Shipping Channel for landing and takeoff of their waterborne craft since the 1920s.

SUBMERGED USES

There are a number of submerged Bay uses that may elude even the most frequent Bay users. Within every Unit of the APMA there are cable and/or pipeline crossing areas. Electric, phone, gas, water, and sewer lines cross the Bay bottom to Miami Beach and other offshore islands. In some cases these lines follow causeways, but in basins V, VII, and VIII, the pipeline and cable areas criss-cross the basin bottoms (see Figure 43).

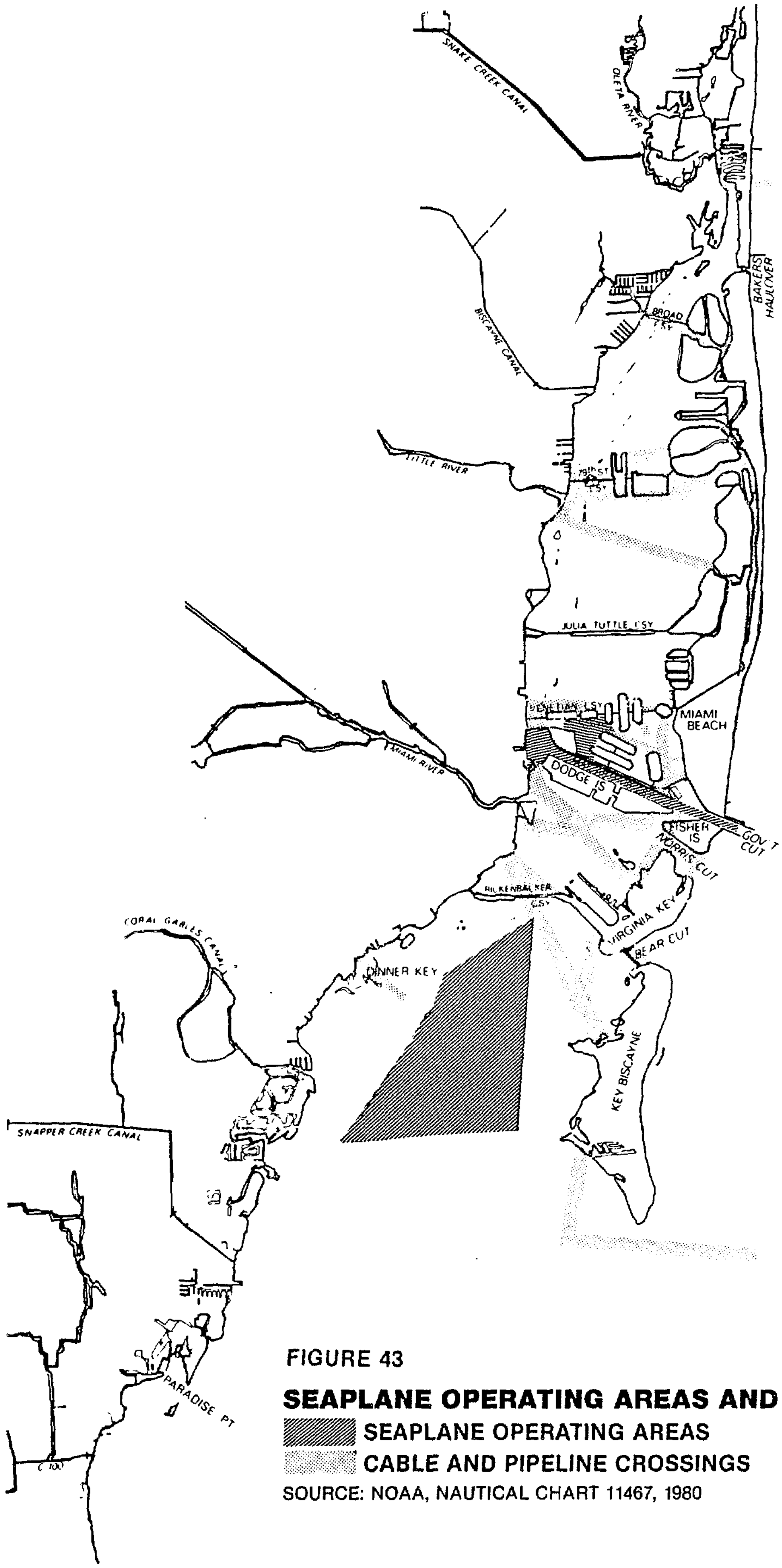


FIGURE 43

SEAPLANE OPERATING AREAS AND UTILITY EASEMENTS

SEAPLANE OPERATING AREAS

CABLE AND PIPELINE CROSSINGS

SOURCE: NOAA, NAUTICAL CHART 11467, 1980

In some instances, the pipes or cables are simply laid across the bottom, while in other areas they are buried beneath the bottom. Years ago Florida Power and Light cables were buried beneath grass beds on the north side of West Point on Key Biscayne (Unit VIII). The dredge scars through the lush grass beds remain apparent and distinct in 1986 aerial photos.

The Bay bottom has become littered with fully and partially submerged vessels. The majority are located in Units II, III, VII, and VIII in the Dinner Key mole island area. These wrecks are clearly marked on navigation charts (see figure 44).

Derelict and deteriorating vessels affect not only water quality but also the utility of the Preserve. Currently, there are no Federal, State or local programs to assist boaters in disposing of unwanted boats. This leads to the stripping and abandonment of boats in areas such as Palmer Lake, the Miami River and the Dinner Key Area. The larger, floating vessels are usually sought for the offshore artificial reef program, but there is no program to rid the Preserve Management Area of most of the smaller sunken vessels.

As mentioned previously, there are five artificial reefs located in the Aquatic Preserve (see figure 44). The artificial reef constructed just offshore north Bayshore Park in Unit II (NE 123 Street) can be reached by a wooden boardwalk that doubles as a fishing pier. In Unit III, just south of the 79 Street Causeway, four low profile artificial reefs can be fished from a pier and the shore.

In the borrow channel north of the Julia Tuttle Causeway, there is an artificial reef that was started many years ago. Clearly marked on navigation charts as "Fish Haven" this reef is accessible only to the boating public.

Straddling Units VII and VIII is a shallow reef between the old and new Rickenbacker bridges, which is accessible to fishermen using the catwalk on the old bridge. Materials from the Rickenbacker Causeway project were also barged to a reef site located offshore of Mercy Hospital. This site is inaccessible from the shore, but the Mercy Hospital reef is widely used by the boating public.

PUBLIC SAFETY

The shoreline, in-water and submerged uses of the Preserve not only affect the utility of this area, but also influence the degree to which the public may safely use this resource area. Increases in population, changes in the demographics of the Dade County area, increased use of high speed/high tech equipment in the confined areas of the APMA have made boating and fishing less safe that they were a few decades ago in the Biscayne Bay area.

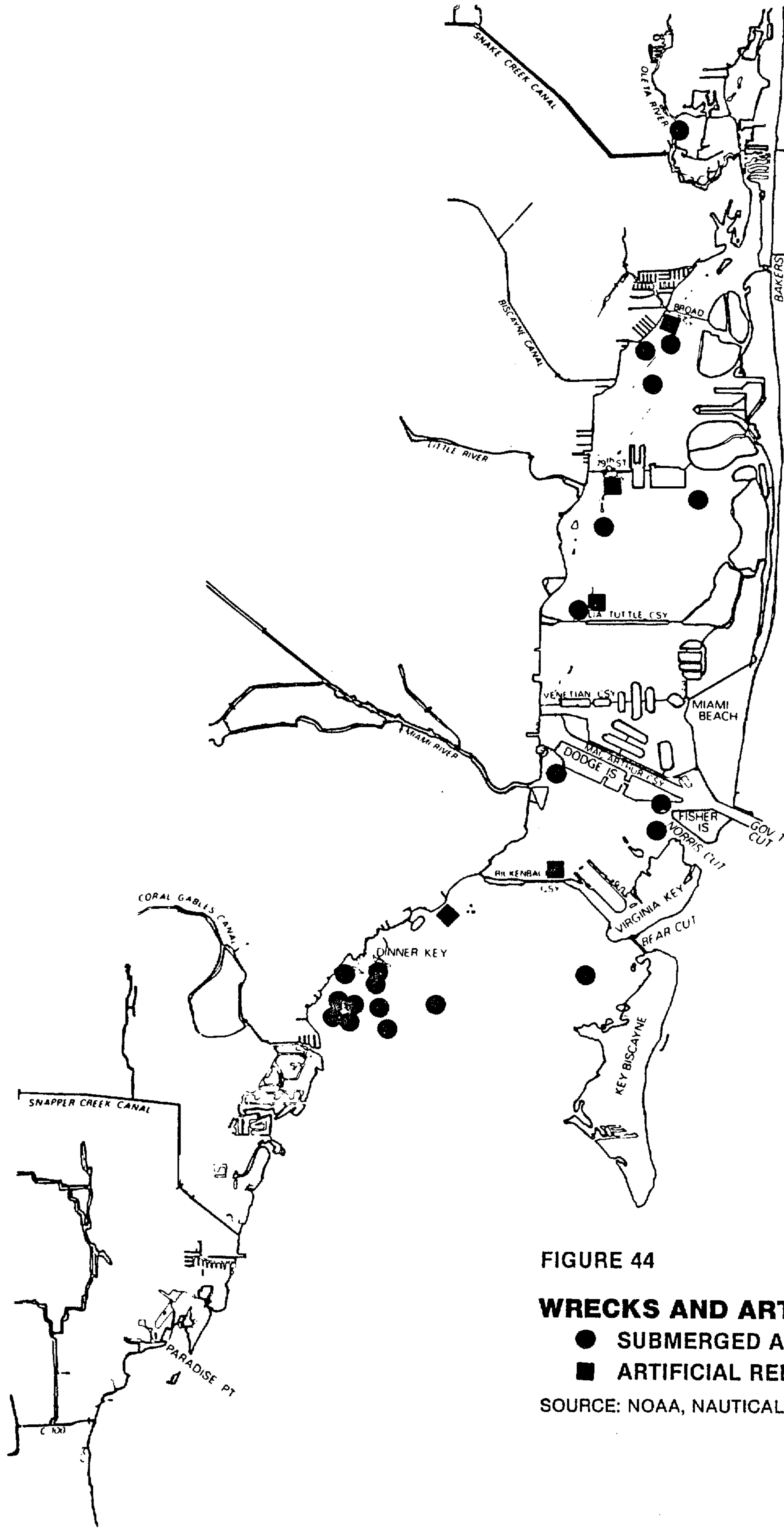


FIGURE 44

WRECKS AND ARTIFICIAL REEFS

● SUBMERGED AND VISIBLE WRECKS

■ ARTIFICIAL REEFS

SOURCE: NOAA, NAUTICAL CHART 11467, 1980

BOATING SAFETY

According to Florida DNR Marine Patrol statistics, serious boating accidents have increased 72 percent statewide since 1981. During 1984 there were 58 reported boating accidents in Dade County. The number of boating-related arrests in Dade has more than doubled in the last four years. From January 1984 through January 1986, there were 18 serious boating accidents (including injuries or fatalities) reported to the Florida DNR Marine Patrol in the Aquatic Preserve Management Area (DNR, 1986). Thirty-one people were injured and four were killed in these incidents (see Figure 45).

There are a number of reasons for boating accidents, most of which are avoidable. One major cause identified by the Marine Patrol is neglect. Many vessels do not carry safety equipment at all or they carry equipment that does not meet minimum standards set by the Coast Guard. On some boats safety gear is neglected and will not serve its intended purpose should an emergency arise.

Drunken driving is another major cause of boating accidents. Although always a dangerous practice, until 1985 it was not illegal to drive a boat drunk or under the influence of drugs. During 1985 the Florida (DNR) Marine Patrol arrested eleven boat operators under new DUI laws.

Boat operators are not required to be licensed, many are unskilled in handling their vessels, do not know, or ignore, the traffic rules and do not understand the navigational markings on the water. There are a number of free and inexpensive courses available on boating safety, boat handling and seamanship, however, few boaters take advantage of these courses. Proper education for the boating public will remain a problem until legislation is passed which requires boat owners and operators to learn the basics of safe boating.

FISHING SAFETY

According to the DNR Marine Patrol (Clark, personal communication) many calls for assistance during shrimping season result from conflicts for space along the bridges and conflicts between bridge users and boats with fixed trawls. In the first case, a few individuals may preempt others from using bridges for traditional dip netting, by stringing nets from the pilings or by using multiple nets. In the latter case, boaters with fixed trawls illegally get too close to the bridges.

BOATERS HURRICANE EVACUATION PLAN

The Biscayne Bay area has not been hit by a major hurricane since 1965. The number of boats docked and moored in Biscayne Bay Aquatic Preserve has, however, increased substantially during these 20 years. Currently, hurricane evacuation plans for the area do not adequately advise the boating public about moving their vessels to safe harbor. During recent hurricane warnings boaters crowded the Miami River and other Bay tributaries and canals seeking refuge. Boaters had to compete with vehicular

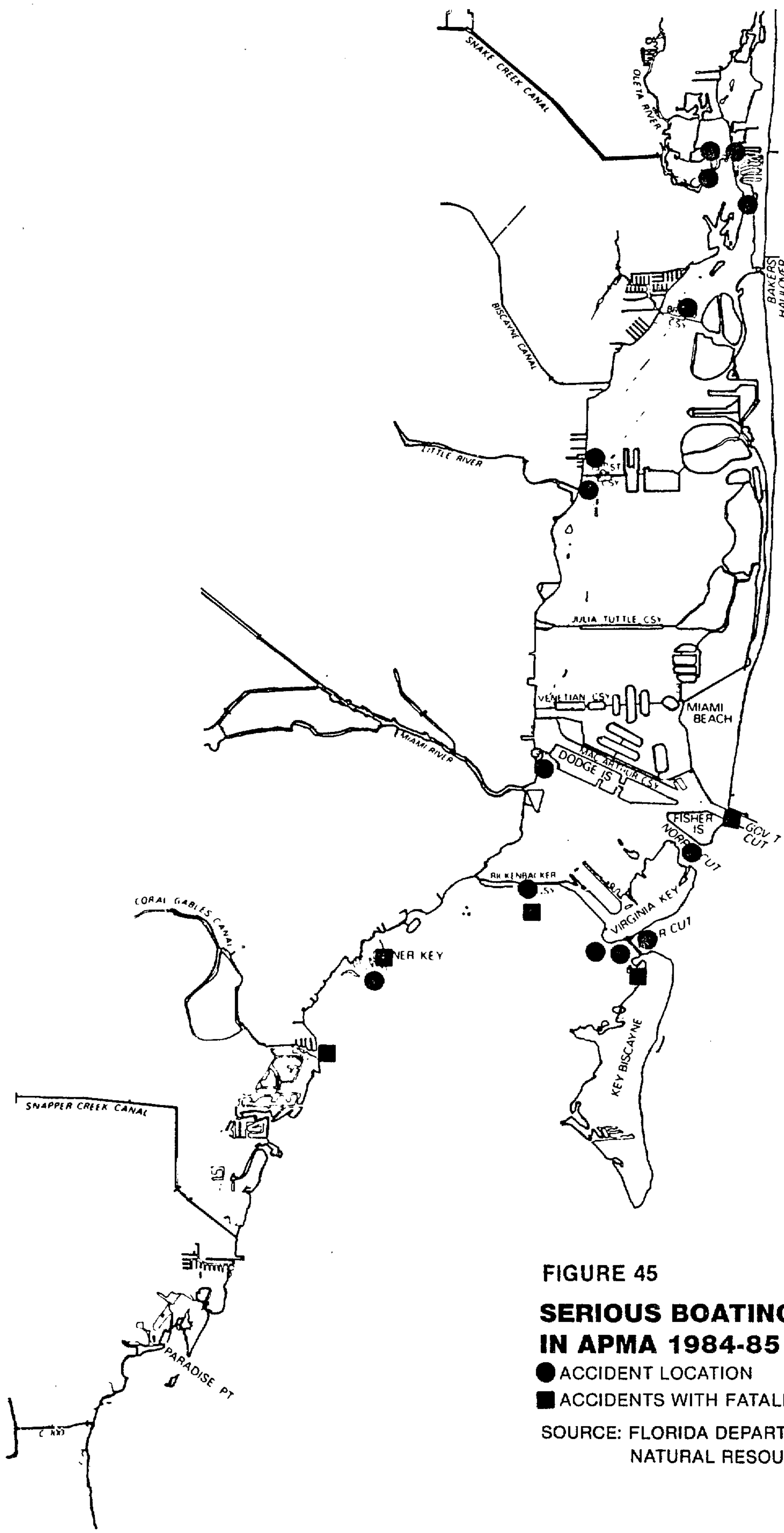


FIGURE 45

SERIOUS BOATING ACCIDENTS IN APMA 1984-85

● ACCIDENT LOCATION

■ ACCIDENTS WITH FATALITIES

SOURCE: FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1986 traffic when requiring bridge openings; and once sustained winds reached over 40 miles per hour, most of the Bay causeway and river bridges were inoperable.

The problems associated with the search for safe harbor are exacerbated by the lack of space, lack of time, and failure of individual boat owners to make prearranged plans for their boats. It is estimated that there is room for about 1,000 boats to anchor in the Miami River (Bishop in Eyerdam, 1986), but there are approximately 9,000 boats in Dade County that will require safe harbor. Once a hurricane warning is issued, boat owners will have only three and one-half hours to move their boats to safe harbor before the bridges are locked shut and the Coast Guard ceases to operate the flotilla plan. Finally, boat owners are responsible for damage done to public marinas if their boat is not moved and they may lose their moorage rights at public marinas or private clubs for failure to comply with orders to evacuate.

As stated by Marty Bishop, Chief of Emergency Preparedness for Dade County, "... There are no laws that assure boaters safe harbor during a storm and it is not the responsibility of government agencies to provide assistance for boaters who have not reserved space. Once the storm hits, you are on your own" (Eyerdam, 1986).

All of the above argues forcefully for the preparation of something more comprehensive than the existing flotilla plan. At a minimum, a boating evacuation plan should be prepared to:

- describe what individual boat owners in all of the major public and private marinas in Dade County expect to do with their boats in the event of a hurricane,

- identify areas of potential conflicts; and

- suggest appropriate solutions.

PUBLIC AWARENESS

The public's understanding of a natural resource, such as Biscayne Bay, has a direct bearing on the care and sensitivity with which the resource is treated. Most members of the public would not set about to deliberately destroy the Bay, however without an understanding of the living resource, people will continue to do seemingly insignificant things; such as dumping oil or solvents down storm drains, tossing yard clippings over bulkheads, or careless things, such as running aground in shallow grass beds.

Just as it is a truism that public awareness is the cornerstone of management of any resource that is used by the general public, it is also true that public awareness has been the weak link in Bay management. Brochures and displays on Bay resources and habitat protection need to be provided at parks, boat ramps, marinas, fishing piers, and other public shoreline facilities. Navigational aides, information signs, and additional regulatory markers need to be installed in the Bay in order to protect shallow and sensitive habitats and to identify protected areas such as the Spiny Lobster Sanctuary, the Biscayne Bay Aquatic Preserve and Biscayne National Park. Most importantly the Dade County School Board needs to develop a comprehensive program to teach the importance of the Bay's natural resources. Such programs would not only help to protect the Bay by making the public more aware of its unique qualities and frailties, but would also enhance the public's ability to experience and appreciate the Bay.

PART V

MANAGEMENT OF THE BISCAYNE BAY AQUATIC PRESERVE

Management of the Biscayne Bay Aquatic Preserve is provided collectively by many agencies acting under the authority of hundreds of laws and administrative rules. However, primary guidance is provided by the Biscayne Bay Aquatic Preserve Act (Chapter 258, Florida Statutes), which declares that "it is the intent of the Legislature that Biscayne Bay be preserved in an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations." The Act sets strict conditions governing minimum dredging and filling, specifies that regulation should not interfere unreasonably with lawful and traditional uses of the Preserve, prohibits the use of seines or nets within the Preserve except for catching shrimp or mullet, protects riparian rights, prohibits the discharge of wastes that will substantially inhibit the accomplishment of the intent of the Act, and provides for enforcement.

The administrative rules adopted by the Governor and Cabinet pursuant to the Act (Chapter 16Q-18, F.A.C.) state that the Preserve shall be administered and managed in accordance with the following goals:

* to preserve, protect, and enhance Biscayne Bay and all natural waterways tidally connected to the bay by "reasonable regulation" of human activity within the Preserve through the development and implementation of a comprehensive Management program;

* to protect and enhance the waters of the Preserve so that the public may continue to enjoy the traditional recreational uses of those waters such as swimming, boating and fishing;

* to coordinate with federal, state, and local agencies to aid in carrying out the intent of the legislature in creating the Preserve;

* to use applicable federal, state, and local management programs, which are compatible with the intent and provisions of the Act and these rules, to assist in managing the Preserve;

* to encourage "activities" that protect or enhance the biological and aesthetic values of the Preserve including, but not limited to, the modification of existing man-made conditions toward their natural condition.

* to preserve and promote indigenous life forms and habitats including, but not limited to, sponges, soft corals, hard corals, sea grasses, mangroves, mud flats, marine reptiles, game and non-game fish species, marine mammals, tropical marine invertebrates, birds and shellfish;

* to acquire additional title interests in land wherever such acquisitions would serve to protect or enhance the biological or aesthetic values of the Preserve.

The rules promulgated pursuant to these objectives are directly applicable to all activities administered by FDNR. It should also be noted that the Wetlands Protection Act of 1984 empowered FDER to promulgate and adopt stricter rules for Outstanding Florida Waters and aquatic preserves than are currently being utilized by that department, for coastal construction activities such as dredge and fill.

In addition to the guidance provided by the Biscayne Bay Aquatic Preserve Act, management of this area is governed by several federal, state and local laws, including but not limited to The National Environmental Protection Act of 1969; The Coastal Zone Management Act of 1972; The Fish and Wildlife Coordination Act; The Clean Water Act of 1977; "State Lands," Chapter 253, Florida Statutes; "Saltwater Fisheries," Chapter 370, Florida Statutes; "Pollutant Discharge Prevention and Removal," Chapter 376, Florida Statutes; "Environmental Control," Chapter 403, Florida Statutes; "Boats, Docks and Waterways," Section 7, Metro-Dade County Code; "Environmental Protection," Chapter 24, Metro-Dade County Code; "Seaport Security and Operations," Chapter 28-A, Metro-Dade County Code; and "Biscayne Bay Management," Chapter 33-D, Metro-Dade County Code.

Therefore, there is a very large body of law that can be called upon for various management functions in the Preserve. Table 14 lists the laws and agencies that are most important from the standpoint of daily management of this area.

While each of the areas outlined in Table 14 is important, two regulatory functions are of primary importance in the management of the Biscayne Bay Aquatic Preserve. The first is coastal construction permitting and the second is submerged land leasing.

COASTAL CONSTRUCTION PERMITTING

Several agencies regulate the placement of structures and dredging and filling activities within the Biscayne Bay Aquatic Preserve. These include the U.S. Army Corps of Engineers, the Florida DER, the Florida DNR, Metro-Dade DERM and the shoreline municipalities.

The Corps' permitting procedures are designed to (1) restore and maintain the integrity of the nation's waters; (2) maintain the navigability of waterways and (3) protect ocean waters from pollutants dumped by vessels. Unless specifically exempted by a general or nationwide permit, construction of structures and other work, discharge of fill material, and transportation of dredged material for the purpose of dumping in ocean water, requires a Corps permit. The Corps' decision on whether or not to issue a permit is based upon an evaluation of several factors, including conservation, economics, aesthetics, historic values, fish and wildlife values, navigation and recreation. Bridges, artificial uplands, fixed structures over navigable waters and overhead pipelines also require a special permit from the U.S. Coast Guard.

TABLE 14

LAWS GOVERNING
BISCAYNE BAY AQUATIC PRESERVE MANAGEMENT

I. GENERAL

Federal

*Enforcement of all laws of the United States/U.S. Coast Guard, Title 14 USC, Sec. 89.

State

*Establishment of policy to conserve and protect natural resources and scenic beauty/Governor and Cabinet; State of Florida Constitution, Article 2, Section 7.

*Adoption and promulgation of regulations for Biscayne Bay Aquatic Preserve/Governor and Cabinet, Florida Department of Natural Resources -- Chapter 258.397 Florida Statutes

Local

*Administration of units of County government charged with and carrying out policies adopted by the Board of County Commissioners/Metro-Dade County Manager -- Dade County Charter: Sections 3.04(A) and 4.02.

*General police powers/City of Miami -- Charter Section 3(y)(2) and Chapter 42, City of Miami Code.

II. WATER QUALITY

Federal

*Enforcement of the Clean Water Act of 1977, as amended, including operation and enforcement of the National Pollution Discharge Elimination System, establishment and enforcement of national water pollution control standards, engagement in general research on water pollution, and provision of grants for pollution research and control programs/EPA -- Title 33 U.S. Code and Title 40 Code of Federal Regulations.

*Development, promulgation and enforcement of laws regulating marine sanitation devices/U.S. Coast Guard -- Title 33 USC, Section 1322; Title 33 CFR, Sections 159.1-205; Title 49 CFR, Sections 1.45-6.

*Enforcement of regulations to control and prevent the discharge of oil or hazardous substances into the waters of the U.S. from vessels or vessel facilities/U.S. Coast Guard -- Title 33 USC, Section 1321.

TABLE 14 (continued)

State

*Enforcement of rules and regulations pertaining to sanitation and control of communicable diseases/Department of Health and Rehabilitative Services -- Chapter 381, Florida Statutes.

*Protection and maintenance of water quality through adoption of standards, permitting and enforcement/Florida Department of Environmental Regulation -- Chapter 403.F.S. and Chapters 17-3 and 4, Florida Administrative Code.

*Enforcement of laws governing oil spill control and recovery/ Florida Department of Natural Resources -- Chapter 376, Florida Statutes.

*Administration of Florida Coastal Protection Trust Fund/Florida Department of Natural Resources -- Chapter 376.11 Florida Statutes.

Local

*Enforcement of prohibitions governing the discharge of material that may cause the receiving waters to fail to meet water quality standards/Metro-Dade Department of Environmental Resources Management -- Chapter 24 of the Code of Metropolitan Dade County.

*Enforcement of regulations governing the discharge of materials, including garbage, trash and litter from vessels and enforcement of provisions requiring vessels to be equipped with the U.S. Coast Guard approved marine sanitation device or a holding tank/City of Miami Beach -- Chapter 7-94, City of Miami Beach Code; City of Miami -- Chapter 50 City of Miami Code.

*Enforcement of laws governing dumping and littering and public nuisances/Metro-Dade County -- Chapters 15-6 and 19 of the Code of Metropolitan Dade County.

*Enforcement of laws governing trash and litter/Town of Bay Harbor Islands -- Section 23-13(3) Town of Bay Harbor Islands Code.

*Enforcement of laws governing nuisance abatement, including dumping of trash and litter/City of Miami -- Section 3( ) and 38-43(p) of the City of Miami Charter and Sections 23-5 through 9, 53-43, City of Miami Code.

*Enforcement of laws governing the dumping of flamable materials, dumping oil in the Miami River, and marine pollution in general/City of Miami -- Chapters 19-309, 37-55 and 50-56, City of Miami Code.

TABLE 14 (continued)

III. COASTAL CONSTRUCTION PERMITTING

Federal

*Regulation of construction of any structure in or over navigable waters of the United States and provision of penalties for violations of such regulations/U.S. Army Corps of Engineers -- Title 33 USC, Sections 403 and 406; Title 33 CFR, Sections 320, 322, 325, 326, 329, 330 (Note: See 33 CFR Sections 322 and 330 for definition and policies relating to general regional and nationwide permits).

*Regulation of construction and operation of bridges/U.S. Coast Guard -- Title 5 USC, Section 559; Title 14 USC, Sections 84, 92, 633; Title 33 USC, Sections 494, 499, 521; Title 49 USC, Section 1655q; Title 33 CFR, Chapter 1, Subchapter J.

*Regulation of artificial islands, causeways, overhead pipelines and fixed structures in navigable waters/U.S. Coast Guard -- Title 14 USC, Sections 81, 86, 92, 633; Title 33 CFR, Sections 67.01-1 to 67-01-50.

*Review of all permit applications for work in navigable waters or wetlands to conserve wildlife resources/U.S. Fish and Wildlife Service -- Title 16 USC, Sections 661-663.

State

*Regulation (subject to limitations and exemptions of Sections 403.501-515 and 403.813, Florida Statutes) of construction and maintenance of piers, wharves, docks, dolphins, mooring pilings, riprap and revetments, retaining walls, groins, break waters, jetties, boat ramps and launching facilities, utility installations, artificial reefs, channels and canals, navigational aids, commercial signs, platforms, fences, bridges, walkways; dredging, filling, and transportation of dredged material/Florida Department of Environmental Regulation -- Chapters 258 and 403 Florida Statutes; Section 17-4.28 and 17-4.29 Florida Administrative Code (Note: For description of exemptions see Section 17-4.04(10), Florida Administrative Code).

*Promulgation and enforcement of regulations in the Biscayne Bay Aquatic Preserve/Trustees of the Internal Improvement Trust Fund, Florida Department of Natural Resources -- Chapter 258.397, Florida Statutes; Chapters 16 Q-18 and 16 Q-20, Florida Administrative Code.

Local

*Regulation of dredging and filling and any type of work in or upon tidal waters, submerged bay bottom lands, or coastal or freshwater wetlands in Dade County/Board of County Commissioners, Metro-Dade Department of Environmental Resources Management -- Chapter 24-58 of the Code of Metropolitan Dade County (Note: Exceptions in 24-58(1).

TABLE 14 (continued)

*Establishment of regulations and procedures governing filling of land, construction of bulkheads, seawalls, piers, docks, groins, marine railways and other similar structures in Biscayne Bay/City of Miami -- Chapter 29, Articles II and III, City of Miami Code.

*Prohibition against dredging or filling in Biscayne Bay or its adjoining canals within the municipal limits of Miami Beach except where fill would be less than one-half acre, and where fill is adjacent to an already existing land mass for the purpose of repairing or improving a shoreline or seawall/City of Miami Beach -- Section 7, City of Miami Beach Charter (Note: This prohibition does not apply to any marina on publicly owned land between MacArthur Causeway and Government Cut, nor to municipally owned land at the westerly portion of Normandy Golf Course bordering Biscayne Bay).

*Establishment of bulkhead and harbor lines/City of Miami Beach -- Chapter 15, City of Miami Beach Code.

*Regulation of dredging and filling/City of Coral Gables -- Chapter 9A, City of Coral Gables Code.

*Regulation of construction of docks, and mooring piles/City of Coral Gables -- Chapter 7-5 and 7-6, City of Coral Gables Code.

*Regulation of coastal construction activities including dredging and filling/City of Miami -- Section 29, Articles 11-111, City of Miami Code; Town of Surfside -- Section 6, Town of Surfside Code; City of North Miami -- Sections 13 and 29, City of North Miami Code.

IV. RESOURCE CONSERVATION

Federal

*Enforcement of laws governing the protection of wildlife and their habitats/U.S. Fish and Wildlife Service

*Enforcement of rules and regulations protection of Marine Mammals and Endangered Species/U.S. Fish and Wildlife Service, Title 16 USC, Sections 1361-1407 and 1531.

*Enforcement of provisions related to monitoring and preservation of marine fisheries/National Marine Fisheries.

State

*Preservation and management of marine fishes and shell fishes/ Florida Department of Natural Resources -- Chapter 370, Florida Statutes.

*Regulation of saltwater fishing and provision of funds for construction of artificial reefs/Florida Department of Natural Resources -- Chapter 370, Florida Statutes.

TABLE 14 (continued)

*Protection of endangered species/Florida Department of Natural Resources -- Chapter 372, Florida Statutes.

*Administration of land acquisition for the purposes of natural resource protection/Florida Department of Natural Resources -- Chapters 259 and 253.023, Florida Statutes.

*Regulation of surface and groundwaters including provision of sufficient water flows to protect fish and wildlife/Florida Department of Environmental Regulation; South Florida Water Management District -- Chapter 373, Florida Statutes.

*Administration of state aquatic preserves, wilderness preserves, and endangered lands programs/Florida Department of Natural Resources -- Chapters 258 and 259, Florida Statutes.

Local

*Enforcement of rules and regulations to protect the Biscayne Bay Aquatic Park and Conservation Area and to administer the Biscayne Bay Management Plan/Metro-Dade County Board of County Commissioners -- Chapters 7 and 33-D of the Code of Metropolitan Dade County.

*Protection and enhancement of the natural resources of Biscayne Bay/Metro-Dade Department of Environmental and Resources Management, Restoration and Enhancement Program.

*Protection of trees and mangroves/Metro-Dade Department of Environmental Resources Management -- Chapters 24-58 and 26-B of the Code of Metropolitan Dade County.

*Designation and protection of environmental protection districts/City of Miami -- Chapter 17-6, City of Miami Code.

V. VESSEL USE AND STORAGE

1. General Laws and Regulations

Federal

*Regulation of commerce/U.S. Coast Guard and U.S. Army Corps of Engineers -- Article 1, Section 8 of the United States Constitution.

*Establishment and enforcement of navigation rules for all vessels and control over movement of all registered vessels/U.S. Coast Guard, Title 33 USC, Section 157; Title 14 USC, Section 89; Title 50 USC, Section 191; Title 33 CFR, Chapter 1, Subchapter D.

TABLE 14 (continued)

State

*Promulgation of regulations and enforcement of laws and regulations governing boating/Florida Department of Natural Resources; Florida Marine Patrol -- Chapter 327.04, Florida Statutes.

Local

*Enforcement of boating laws (except in ICW) subject to jurisdiction of the United States and the State of Florida/Metro-Dade County and shoreline municipalities -- Chapters 125.012, 327.22 and 327.60, Florida Statutes; Chapter 2-92(h) and 7-21 to 7-28, Code of Metropolitan Dade County; Chapter 7-10 and 11, City of Coral Gables Code; Chapter 7-24 to 7-36 and 25-59 City of Miami Beach Code; Section 15-3, City of North Miami Code; Ordinance #44 of Indian Creek Village; Chapter 50, City of Miami Code.

2. Aids to Navigation

Federal

*Establishment, maintenance and operation/U.S. Coast Guard -- Title 14 USC, Sections 81, 86, 92, 633; Title 33 CFR, Chapter 1, Subchapter I.

State

*Promulgation and enforcement of regulations governing regulatory markers on ICW/Florida Department of Natural Resources, Florida Marine Patrol -- Chapter 327.40-42, Florida Statutes.

3. Search and Rescue Operations

Federal

*Conduct of such operations/U.S. Coast Guard, Title 14 USC, Section 88.

4. Abandoned/Derelict Vessels

Federal

*Monitoring, and in some cases removal of wrecks or obstructions to navigable waters/U.S. Army Corps of Engineers -- Title 33 USC, Sections 401, 409, and 414; Title 33 CFR 209.190.

State

*Establishment of authority to remove derelict vessels from public waters and assistance to county and municipal authorities in identification and disposition of abandoned vessels in public waters/Florida Department of Natural Resources, Florida Marine Patrol -- Chapters 376.15, Florida Statutes and Chapter 16 N-23, Florida Administrative Code.

TABLE 14 (continued)

Local

*Enforcement of nuisance vessel laws for removal of vessels constituting public nuisances in the Miami River and its tributaries, including provisions for notice, hearing at the request of vessel or upland owner, right of County to collect costs and civil actions/Metro Dade County -- Chapter 7-46 to 7-49 of the Code of Metropolitan Dade County.

*Removal of nuisance vessels -- Chapter 7-9 City of Coral Gables Code.

*Regulation of nuisances and abandoned property and authority to dispose of derelict vessels/City of Miami Beach -- Chapters 7-83, 7-84, and 25-61 and 25-62, City of Miami Beach Code.

*Enforcement of regulations governing abandoned/derelict vessels/City of Miami -- Chapter 50, Articles I and IV, City of Miami Code.

5. Protection and Security of Vessel Facilities

Federal

*Enforcement of laws to provide security to waterfront facilities and vessels/U.S. Coast Guard -- Title 50 USC, Section 191; Title 33 CFR, Sections 6.01 to 6.19.

*Promulgation and enforcement of rules, regulations, and plans for the Port of Miami including lay up procedures, Shipboard Fire Contingency Plans and Miami Florida Hurricane Protection Plan/U.S. Coast Guard -- Title 33 USC, Sections 1221, 1223 and 1225; Title 33 CFR, parts 6 and 160.

Local

*Regulation of marinas, mooring and rental facilities within County park property/Metro Dade County Park and Recreation Department -- Chapters 2-86 and 26-1 Dade County Code.

*Administration and enforcement of regulations re: docks and marine facilities/City of Miami Beach -- Chapter 7, Articles V and IX; City of Miami Beach Code; City of Miami -- Chapter 53, Article II, City of Miami Code.

Anchorages and Moorages

Federal

*Establishment, promulgation, and enforcement of rules and regulations/U.S. Coast Guard -- Title 33 USC, Sections 180, 471; Title 49 USC, Section 1655(g)(1); Title 33 CFR, Chapter 2, Subchapter I.

TABLE 14 (continued)

Local

*Enforcement of County vessel mooring code and barge mooring code/Metro-Dade County, Marine Patrol -- Chapter 2-92(h) and 7-32 to 7-40, and 7-55 to 7-60, Code of Metropolitan Dade County.

*Regulation of mooring and anchorages/Coral Gables -- Charter of Coral Gables 8 (15) and Chapter 7-20 and 7-11, City of Coral Gables Code; City of Miami Beach -- Chapter 7-30, 7-31, 7-39, 7-58, 7-62, 7-65, 7-69, City of Miami Beach Code; City of Miami -- Chapter 50, Article IV, City of Miami Code; and Indian Creek Village -- Ordinance #44.

VI. PUBLIC ACCESS

State

*Administration of regulations governing the management, sale, transfer or lease of State owned lands/Trustees of the Internal Improvement Trust Fund, Florida Department of Natural Resources -- Chapter 253, Florida Statutes, and Chapter 16Q-20, Florida Administrative Code.

*Administration of the Federal Land and Water Trust Fund/Florida Department of Natural Resources Chapter 16D-5, Florida Administrative Code.

*Administration of State parks, historic monuments, and recreational areas/Florida Department of Natural Resources -- Chapter 258, Florida Statutes.

*Acquisition of land for outdoor recreation/Florida Department of Natural Resources -- Chapter 375, Florida Statutes.

*Administration of the Florida Recreational Development Assistance and the Boating Improvement Trust Funds/Florida Department of Natural Resources -- Chapters 375 and 327, Florida Statutes, and Chapter 16D-5, Florida Administrative Code.

Local

Administration of County parks/Metro-Dade Park and Recreation Department -- Chapters 25-B and 36, Code of Metropolitan Dade County.

*Provision of shoreline access on Rickenbacker Causeway/Metro-Dade Public Works Department -- Chapters 9 and 26, Code of Metropolitan Dade County.

*Provision of shoreline access at municipal parks bordering the APMA -- Cities of North Miami, Miami Shores, Miami Beach and City of Miami, Chapter 38, City of Miami Code.

At the state level authority to regulate coastal construction and dredging and filling activities within the Biscayne Bay Aquatic Preserve is primarily derived from "The Florida Air and Water Pollution Control Act," Chapter 403, Florida Statutes, which is based upon the general police powers of the state, plus the policy to conserve and protect the State's natural resources and scenic beauty as set forth in the Florida Constitution. Subject to exemptions listed in Chapter 403.813, Florida Statutes and 17-4.04 (10), Florida Administrative Code, the FDER has regulatory authority over all of the coastal construction and dredging and filling activities in the Preserve.

Locally, the Metro-Dade DERM has broad regulatory powers over dredging and filling and the performance of work in, on, or upon tidal waters, submerged bay bottom lands, or in coastal or freshwater wetlands in Dade County. Section 24-58 of the Metro-Dade County Code provides a comprehensive approach to local regulation of dredge and fill and coastal construction activities.

Both the State and County permitting agencies require, and generate water quality and other data in order to evaluate coastal construction permit applications. According to Chapter 403.929, Florida Statutes, Florida Department of Environmental Regulation is required to establish a computerized wetlands monitoring system which locates wetlands; maintain a statistical record of permit actions taken; and, identify the impacts and losses to wetlands due to permitted, unregulated or exempted activities. However, this Florida Statute (§403.939[2]) also clearly states that this information "... shall not be used for regulatory purposes."

In addition, as part of the County's coastal construction permitting process, data is required to evaluate the environmental impacts of proposed projects (Chapter 24-58.3, Dade County Code). At this time, neither the County nor the State uses these required data when similar activities are proposed in other areas of the Preserve.

The State and County permitting procedures for the construction of marina facilities contains provisions for protecting the environment. After a facility is complete, however, there are no follow-up mechanisms to ensure long-term compliance with permit conditions. Permit requirements for pump out stations, sewer hookups for liveaboards, and oil/fuel spill abatement equipment go unmonitored and therefore unenforced.

SUBMERGED LAND LEASING

There are more than ten permits for new marinas or marina expansions in Biscayne Bay which have been 'on hold' for several years because the necessary DNR submerged land leases have not been issued. In order to get a lease to build a marina on sovereign submerged lands an applicant must demonstrate that: the structures are water dependent; that the project is consistent with the Aquatic Preserve rules and management plans developed for the Preserve; that the project is either a public navigation project, or the creation or maintenance of docks, marinas, piers, shore protection structures, or the installation/replacement or maintenance of navigational aides or public utilities; that the project is in the public interest; and, that an extreme hardship exists for the applicant at the time the application is filed (Chapter 16Q.-18, Florida Administrative Code).

Extreme hardship is defined in 16Q-18.04 FAC as

> "... a significant burden, unique to the applicant and not shared by property owners in the area. Self-imposed circumstances caused to any degree by actions of any person subsequent to the enactment of the Act shall not be construed as an extreme hardship. Extreme hardship under this act shall not be construed to include any hardship which arises in whole or in part from the effect of other federal, state or local laws, ordinances, rules, or regulations. The term may be inherent in public projects which are shown to be a public necessity."

This exteme hardship test has generally precluded the granting of any sovereign submerged land leases to private entities applying for leases to develop a new or expand an existing marina. This is important in light of the fact that over 80 percent of the APMA submerged land is owned by the state, and an overwhelming portion of the remaining 20 percent is owned by other governmental entities. Therefore, there are only a limited number of locations where private developers would not be required to obtain a state land lease prior to going through the rigorous coastal construction permitting process.

Furthermore, the Aquatic Preserve Rules State that extreme hardship"... may be inherent in public projects which are shown to be a public necessity." The State's rule definition of extreme hardship has, therefore, not only precluded private development of marinas or other water dependent projects over sovereign submerged land, but also has placed the burden of meeting future marina demand on the public sector.

DNR (1984) statistics show that 96 percent of marina demand statewide is supplied by the private sector; and only 6.6 percent of all marinas are government owned (DNR, 1984). Yet in Dade County, the City of Miami and Metro-Dade own and operate eight percent of the marinas, providing 23 percent of the area's total number of wet slips and seven percent of its dry slips (Metro-Dade Planning Department, 1986). These facilities also had the highest average occupancy rate (97 percent) observed in the Bay (Metro-Dade Planning Department, 1986). With an additional 898 wet slips and 300 dry slips expected to be completed in the next five years in five public sector projects, the share of government owned and operated wet slips will rise to 33 percent and dry slips to 15 percent of the Baywide total (Metro-Dade Planning Department, 1986). These statistics do not include 64 transient slips at Elliot Key Harbor or the proposed Chapman Field marina project.

In summary, the Aquatic Preserve rule has placed the burden of meeting future marina demand on the public sector, which is already providing a large portion of Dade County's wet and dry boat storage supply. A change in the rule's extreme hardship test could alleviate this inequity. Marina siting criteria could be established to assist both public and private sector developers in determining the merits of a project and the standards by which it will be judged.

AQUATIC PRESERVE MANAGEMENT -- GENERAL RECOMMENDATIONS

The County's Bay Management Plan charted a course that has guided Bay management activities and decisions during the period from 1981 though 1986. Many of the key elements and recommendations contained in that Plan have been implemented. Chief among those are Countywide coastal construction permitting, a shoreline development review procedure and several Bay restoration and enhancement projects. The recommendations that are presented below build upon that framework and set forth priorities to guide future Bay management decisions at both the State and County level. These recommendations were prioritized by the citizens advisory committee that worked with staff in developing this plan.

The recommendations are grouped under the following headings:

Public Awareness and Environmental Education
Water Quality and Turbidity Abatement
Coastal Construction
Resource Conservation
Vessel Storage and Use
Public Access
Public Safety

Within each of these subject areas, the individual recommendations are presented as they were ranked by the advisory committee from the most important to the least important.

PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION

1. Existing environmental education programs should be expanded so that all children in the Dade County Public School system receive "hands on" exposure to Biscayne Bay during grades four through six at a permanent nature center located in the coastal zone.

2. A public outreach program including environmental workshops, TV and radio programs and public service announcements should be developed.

3. A mobile exhibit that could be used at Bayshore parks should be developed to enhance public appreciation and awareness of the Bay.

4. The Bay User Guide, similar to the one published as part of the "1985/6 State of the Bay Report," should be published and distributed where tourist brochures are available, and at Bay shoreline and access points.

5. An ongoing Bay cleanup program should be established. Organizations and groups should be encouraged to 'Adopt an island, park or Bay shoreline area' and keep it clean.

I. WATER QUALITY AND TURBIDITY ABATEMENT

1a. The State and County should provide 24 hour, seven days a week enforcement of pollution control laws on the Miami River and Little River Areas.

1b. All inter-unit connections should be left open and unobstructed to allow water flow to pass freely.

2. The most seriously eroded and eroding shorelines should be identified and stabilized.

3. The State, County and City of Miami should identify and retrofit the worst storm water outfalls (based upon size of drainage, miles of roadway, roadway traffic and, numbers of potentially polluting uses within each storm water drainage basin).

4. The filtering and cleansing functions of existing mangrove shorelines should be preserved.

5. Trash and litter pickup on the islands and along the shoreline of Biscayne Bay should be more frequent than on a monthly basis.

6. The City and County should secure funding to stabilize publicly owned eroding shoreline areas.

7. The State or Federal government should establish revolving loan funds for storm water drainage improvements.

8. Dredge spoil should not be used to construct spoil islands, but rather to fill existing dredged holes provided that the spoil is of proper grain size and quality.

9. All grass beds and hard bottom areas that are less than two feet at mean low tide should be well marked.

10. FDER should initiate a study to determine the relationships between land uses and concentrations of hydrocarbons and other pollutants in storm water runoff.

11. The Dade Canal should be cleaned out from the southern tip of Lake Pancoast to Biscayne Bay.

12. Shoreline municipalities, Dade County and FDNR should publicize the Coast Guard phone number and the DERM pollution hotline number and the DERM used oil collection/recycling program at marinas, shoreline parks and in boat registration mail outs.

13. Any new cuts, submerged or emergent spoil areas that are permitted in association with public navigation projects should be located and designed taking current patterns and wave scour into consideration. They should be stabilized during the construction process.

14. Margins of dredged areas affected by tidal, winter storm or hurricane scour should be "streamlined" by re-profiling.

15. The County should expand its small industrial waste generators and underground tank programs and inventory sources of direct overland runoff from known or suspected hazardous waste sites and upland sources.

16a. The appropriate local government(s) should require liveaboards to obtain occupancy permits. Such permits should only be issued if hookups to landside sewage lines or holding tanks are utilized and maintained.

16b. When alternate sites for disposal of spoil are identified, the Trustees of the Internal Improvement Trust Fund should consider revoking the unused U.S. Army Corps of Engineers perpetual spoil easements within the APMA.

17a. The State or County should establish a regulatory program to reduce pollution from boat maintenance and repair facilities.

17b. "Local government(s) should make provisions for the availability of a mobile pump out unit that would serve boats throughout the APMA that are not already served by the Port of Miami facility."

18. The Coast Guard should delegate authority for enforcement of laws regulating discharge of wastewater and bilge water to state or local governments when those entities are willing and able to enforce Coast Guard regulations.

19. FDER should develop quality standards for marine sediments to be used in the monitoring of estuarine and marine waters.

20. Inlets and other areas that chronically collect trash and debris should be reconfigured to minimize this problem, if feasible.

21. Metro-Dade should establish site(s) where material that is suitable for riprap could be stockpiled for use within the Biscayne Bay Aquatic Preserve.

22. All shipping terminals, marinas, boat yards and boat manufacturing facilities should be required to have secondary containment of underground tanks and associated pipes and monitoring wells with a continuous automatic leak detection system.

II. COASTAL CONSTRUCTION

The following recommendations are proposed to clarify and improve the existing requirements and administrative procedures used by Metro-Dade County and the State of Florida:

1. Only those floating or fixed structures which are water dependent (i.e., uses which cannot exist or occur without association with marine, freshwater or estuarine water masses), and are allowable under all state and local laws should be permitted in, on, over or upon the waters of the Preserve.

2. No filling, spoiling or placement of structures in or over waters of the Preserve should be permitted to diminish water surface areas traditionally used by the general public for activities such as fishing, swimming and boating.

3. FDER should adopt rules pursuant to the Wetlands Act of 1984 (Chapter 403, F.S.) to govern permitting in aquatic preserves. In the rules, FDER should clearly indicate the factors that will be used in a public interest determination, and should define the meaning of "utility" of the preserve to correspond more clearly with the conventional meaning of the word than the definition incorporated in 16Q-18.

4. Chapter 258.397(3)(a) Florida Statutes should be amended to read as follows:

   (a) No further sale or transfer of sovereignty submerged lands in the preserve shall be approved or consummated by the board of trustees, except upon showing of extreme hardship on the part of the applicant and a determination by the board of trustees that such sale or transfer is in the public interest.

   A new paragraph (b) should be created to read:

   (b) No further lease of sovereignty submerged lands in the preserve shall be approved or consummated by the board of trustees, except upon a determination by the board of trustees that such lease is in the public interest.

5. The requirement in Chapter 403.906, F.S. that generally no new vertical bulkheads will be permitted in estuaries or lagoons should be reinterpreted by FDER, when otherwise appropriate, to allow the construction of vertical bulkheads which have turbulence reducing and habitat enhancing design features water-ward of the bulkhead.

6. Information generated as part of the coastal construction permitting process should be used when assessing future applications for similar proposed activities within the APMA. Information compiled in the Wetlands Monitoring System pursuant to the requirements of Chapter 403.929, F.S., plus information generated by the County's Coastal Construction permitting process should be compiled and maintained in a statistical file to be used in assessing proposed coastal construction activities within the APMA.

   Chapter 403.929, F.S. should be amended as follows:

(2) It is the intent of the Legislature that the Department (FDER) utilize existing available information to the greatest extent practicable in developing this inventory of wetlands, including Landsat digital data, federal agency data, and data currently in the possession of the department, the water management districts, and other state, regional, or local agencies. The department shall annually prepare a report reflecting the information requested in paragraphs (1)(b) and (c), to be delivered to the Legislature on or before February 1 of each year. The information contained in this report shall ~~not~~ be used for regulatory purposes.

III. RESOURCE CONSERVATION

1. Bird Key should be purchased by the State of Florida or other public entity. The Trustees of the Internal Improvement Trust Fund should deauthorize the use of this natural area as a potential site for spoil disposal.

2. No further dredging or filling that would result in the destruction of shallows or flats or in the removal of vegetative cover, hard bottom or other viable benthic communities should be permitted in the APMA.

3. Long term monitoring of water quality and Bay habitats should be undertaken to improve the coastal construction permitting process and to guide future Bay restoration and enhancement activities.

4. Certain fragile and shallow bottom areas within the APMA should be identified, posted and designated on navigation charts. These should include, but not be limited to the following areas:

   a) the mud and sand flats and mangrove shore of western Virginia Key;

   b) the mud and sand flats and shallows surrounding Bird Key; and

   c) the mud and sand flats and shallows on the flanks of Pelican Island; and

   d) the seagrass area north of Julia Tuttle Causeway.

5. The impacts of shrimp by catch on juvenile fish populations should be monitored and evaluated.

6. Mangrove areas within and adjacent to the Preserve in the following locations should be designated as "Mangrove Preservation Areas":

Oleta River State Recreation Area
Haulover Park
Bird Key
Near shore islands and northwestern shoreline of Virginia Key
The western shore of Key Biscayne
Bear Cut shoreline
The Cocoplum Mangrove Preserve
Matheson Hammock Park
Snapper Creek Park (former ITT property)
The Deering Estate and Chicken Key
Mangrove forest between the Deering Estate and Gables-by-the-Sea
Paradise Point shoreline
Coastal mangrove forests within and adjacent to Biscayne National Park

In these areas no cutting, trimming, pruning or other alteration of mangroves should be permitted except for purposes of surveying or for projects that are publicly necessary and where no feasible alternative to the mangrove alteration can be found. In such cases the alteration should be kept to the absolute minimum, and done in a manner which preserves the functions of the mangrove system, including:

- improving water clarity by stabilizing the sediment;
- providing substrate, food, and shelter for a wide range of invertebrates;
- creating important near shore nursery grounds for juvenile fish;
- providing a buffer against storm tides;
- cleansing overland runoff;
- providing feeding, roosting, and nesting locations for birds and other wildlife; and
- contributing detrital material and nutrients to the waters of the Preserve.

Mitigation should be required to fully compensate for any short-term or long-term functional losses to the ecosystem. Pruning techniques should be based upon the most credible scientific data, and the pruning or removal techniques used should be designed to insure minimum damage to the individual trees. Any alteration or pruning should be done under expert supervision, and monitored by DERM.

7. There are other stands of mangroves within or bordering the Preserve which perform some or all of the functions enumerated in #4 above. These should be considered as "Mangrove Management Areas," where limited removal and topping of black and white mangrove trees and lateral pruning of red mangrove trees for the purpose of providing necessary maintenance and/or visual access to the Preserve may be permitted.

Mitigation should be required to fully compensate for any short-term or long-term functional losses to the ecosystem. Pruning techniques should be based upon the most credible scientific data, and the pruning or removal techniques used should be designed to insure minimum damage to the individual trees. Any alteration or pruning should be done under expert supervision and monitored by DERM.

8. The State lobster sanctuary should be extended north to the Rickenbacker Causeway.

9. Culverts and other large rubble, should be used to create artificial reefs in deep dredged holes and troughs that meet the following criteria:

   a) they are too deep or turbid to support viable benthic communities;

   b) reef material can be placed in a manner that will not interfere with traditional boating or fishing uses.

   c) they are areas that are prone to accumulate fine bottom sediment that is re-suspended by tidal flow, minor wind stress or boat agitation.

   d) they are preferentially accessible to shoreline fishermen.

10. "Mangrove Mitigation Areas" (i.e. areas where mangroves can be planted, or replanted) should be identified within and adjacent to the Preserve. In selecting such areas the following factors should be taken into consideration:

    a) low energy shorelines where mangroves will be protected and can effectively colonize;

    b) ability to protect the site from public access to allow time for the trees to become established;

    c) sufficient space and proper substrate between mean sea level and mean high water; and

    d) commitment to a monitoring and replanting program.

    Limited pruning of mangroves planted in mangrove mitigation areas may be permitted for purposes of providing necessary maintenance and/or visual access to the Preserve.

11. Landscaping along the APMA shoreline should preferentially consist of appropriate native plant species.

12. Canal impact studies, such as those proposed by the U.S. Army Corps of Engineers, should be carried out as expeditiously as possible. Water and sediment quality, bottom communities and fisheries should be monitored on a continuing basis to detect changes within the APMA.

13. The Marine Fisheries Commission, which is the State entity responsible for rule-making with regard to fisheries conservation should investigate the possibility of reinstituting the use of "bully nets" for lobstering in those portions of the APMA that are outside the lobster sanctuary.

14. A management plan be prepared for the southernmost portion of the Biscayne Bay Aquatic Preserve which is located in Card Sound. The Florida Department of Natural Resources (FDNR) should coordinate a joint Dade/Monroe county management planning project for that area.

IV. VESSEL STORAGE AND USE

1a. The Florida Legislature should initiate a statewide program that requires boat owners and operators to learn the basics of safe boating before operating a vessel in Florida waters.

1b. The impacts of marina siting, design and maintenance on water and sediment quality and marine habitats within the Preserve should be evaluated in order to refine marina permitting policies. In the interim it is recommended that marinas be preferentially located in well flushed areas. Sites selected should require only minimal dredging or filling and should be located so that boat traffic into or out of the marina will not negatively affect mangroves, grass beds, algal or hard bottom communities.

2. Metro-Dade Department of Environmental Resources Management (DERM) and Florida Department of Environmental Regulation (FDER) should initiate a system of periodic checks to ascertain whether, and the extent to which, any marina or its manner of operation is having a negative impact on the quality of the Preserve.

3. A comprehensive study of the need for additional public and private marinas should be done.

4a. The shoreline municipalities and Dade County should work with the U.S. Coast Guard, FDNR, and other appropriate agencies to select, operate, and publicize disposal sites where local boaters can bring unwanted vessels for disposal.

4b. The Federal, State and local agencies should establish a coordinated protocol for marking and removing derelict and abandoned vessels from the Miami River and Biscayne Bay.

5. The Federal government and U.S. Customs should resolve the administrative and legal problems that are keeping vessels seized prior to 1984 from being disposed of expeditiously and economically, and remove derelict seizures from the water onto upland sites until forfeiture proceedings can be completed.

6. The Federal government should make increased use of Dade County's inshore/offshore artificial reef sites for disposal of appropriate forfeited seized vessels.

7. The Coast Guard, FDNR, Metro-Dade County, shoreline municipalities and the marine community should develop a comprehensive hurricane evacuation plan that identifies various locations where boats from the individual units of the Aquatic Preserve Management Area (APMA) can be taken during a hurricane watch.

8a. A boating evacuation plan should be prepared to:

   a. describe what individual boat owners in all of the major public and private marinas in Dade County expect to do with their boats in the event of a hurricane

   b. identify areas of potential conflicts, and

   c. suggest appropriate solutions.

V. PUBLIC ACCESS

1. State, County, and municipally owned Bayfront parks should be redesigned and reprogrammed to afford greater public access to the Bay.

2. The immediate shoreline within the APMA should preferentially be used for water dependent activities and for viewing areas accessible to the general public. Chapter 16Q-18 F.A.C. should be revised to clarify the fact that construction of public shoreline walkways and boardwalks is permissible in areas where they can be constructed without shading or damaging benthic communities, and without violating the private property owners' riparian rights.

3. Wherever feasible, public rights-of-way should be used to provide public access to the Preserve.

4. All parking, gas pumps for automobile and truck fueling, trash dumpsters, trash transfer stations and other unsightly uses on publicly owned uplands within the APMA should be placed away from the shoreline, and buffered from view from the water.

5. All new shoreline landscaping on publicly owned parcels within or adjacent to the Preserve should be done in a manner that enhances views and vistas of the Preserve from the land and of the publicly owned land from the water.

6. Signage along major thoroughfares should direct the public's attention to public Bayfront parks and Bay related facilities. However, no advertisements or signs except Coast Guard approved signs, should be erected on, over, or upon the waters of the APMA.

7. At Chapman Field, a park and marina was approved by the voters of Dade County in 1972. This project is the third and last of the regional marinas planned for south Biscayne Bay. In that area, limited pruning and removal of mangroves may be permitted, provided that no feasible alternative to the pruning and/or removal exists and that the pruning or removal of mangroves is kept to the absolute minimum necessary. As in the "Mangrove Preservation Areas" identified in #4 above, the functions of the mangrove system should be maintained and mitigation should be required to fully compensate for any short-term or long-term functional losses to the ecosystem.

8. Marina siting within the Aquatic Preserve should be based on appropriate upland, shoreline and in-water characteristics, and not just submerged land ownership. Marina siting criteria should be established to evaluate whether or not a marina should be built in a specific location. At a minimum, the following general siting test and specific criteria should be used to determine the appropriateness of sites within the Aquatic Preserve for marina projects.

General Marina Siting Test

a. Will construction or subsequent activities on the proposed marina/water-dependent project site, destroy or negatively impact any of the following, on the immediate site or in surrounding areas:

(1) Viable hammocks/pinelands (as defined in the County's Comprehensive Development Master Plan); or

(2) Mangrove preservation areas (as listed in the this Management Plan); or

(3) one-half acre, or more, of moderately or densely populated seagrass or hard bottom communities (as defined by DERM (1983) in blades per square meter-200+ bl/m^2 Turtle grass; 800+ bl/m^2 Manatee grass; 1,500+ bl/m^2 Shoal grass; or 2+ organisms per square meter in hardbottom communities.

If no, continue with specific siting criteria.

Special Siting Criteria

a. <u>Is the proposed project</u>:

(1) Allowable under existing laws, and
(2) Compatible with existing, surrounding land uses, and
(3) Of sufficient size to accommodate project?

b. Will the proposed project improve or enhance:

(1) Quality of the Preserve, and
(2) Public access to the Preserve, and
(3) Traditional public use of Preserve?

c. Will the proposed project protect:

(1) Archeological or historic site/artifacts, and
(2) Upland, shoreline and in-water habitats, and
(3) Endangered, threatened or rare species?

d. Is there sufficient:

(1) water depth in marina basin, and
(2) water depth in access channel and waterside accessibility, and
(3) water quality, and
(4) water circulation and tidal flushing, and
(5) containment of storm water run-off,
(6) wave/wake protection, and
(7) hurricane protection and/or evacuation plan, and
(8) landside accessibility?

VI. PUBLIC SAFETY

1a. An areawide boating speed limit should be established for all areas within the NPMA and north to the Broward County line.

1b. All areas with repeated boating accidents within the APMA should be posted as idle speed/no wake zones.

2. The Marine Fisheries Commission should investigate problems associated with the use of shrimp trawling nets and multiple nets within the Preserve.

2b. Laws regulating use of shrimp trawling nets near bridges and the use of multiple nets from bridges should be strictly enforced and amended, if necessary.

3. Alternatives to riprap, such as an area of wave absorbing material built into a bulge or seawall, should be evaluated for use in places where riprap is not practical or safe, and where boat wakes create hazards to navigation.

CHAPTER 2

UNIT I

Sunny Isles to Broad Causeway, including the Oleta River

Introduction

The open water area in Unit I covers about 3.5 square miles (Figure 46). About 44 percent of the twenty-four plus miles of shoreline that border the Intracoastal Waterway, the lower Oleta River, "Arch Creek," Little Arch Creek and the Bay, is vertically bulkheaded (see Figure 18). Water depths in this area vary from more than twenty feet to less than two feet at mean low tide with average depths of approximately seven feet (see Figure 14). Seventy-four percent of the Bay area in Unit I is dredged and an additional fifteen percent is naturally barren (see Figure 32).

Circulation is governed primarily by flow into and out of Haulover Cut. Approximately half of the water that enters this unit on an incoming tide is flushed back out into the Ocean on the outgoing tide. The remainder begins a slow (approximately two week) period of flowing in a generally southerly direction until it is finally washed out Government Cut (Van de Kreeke and Wang 1984).

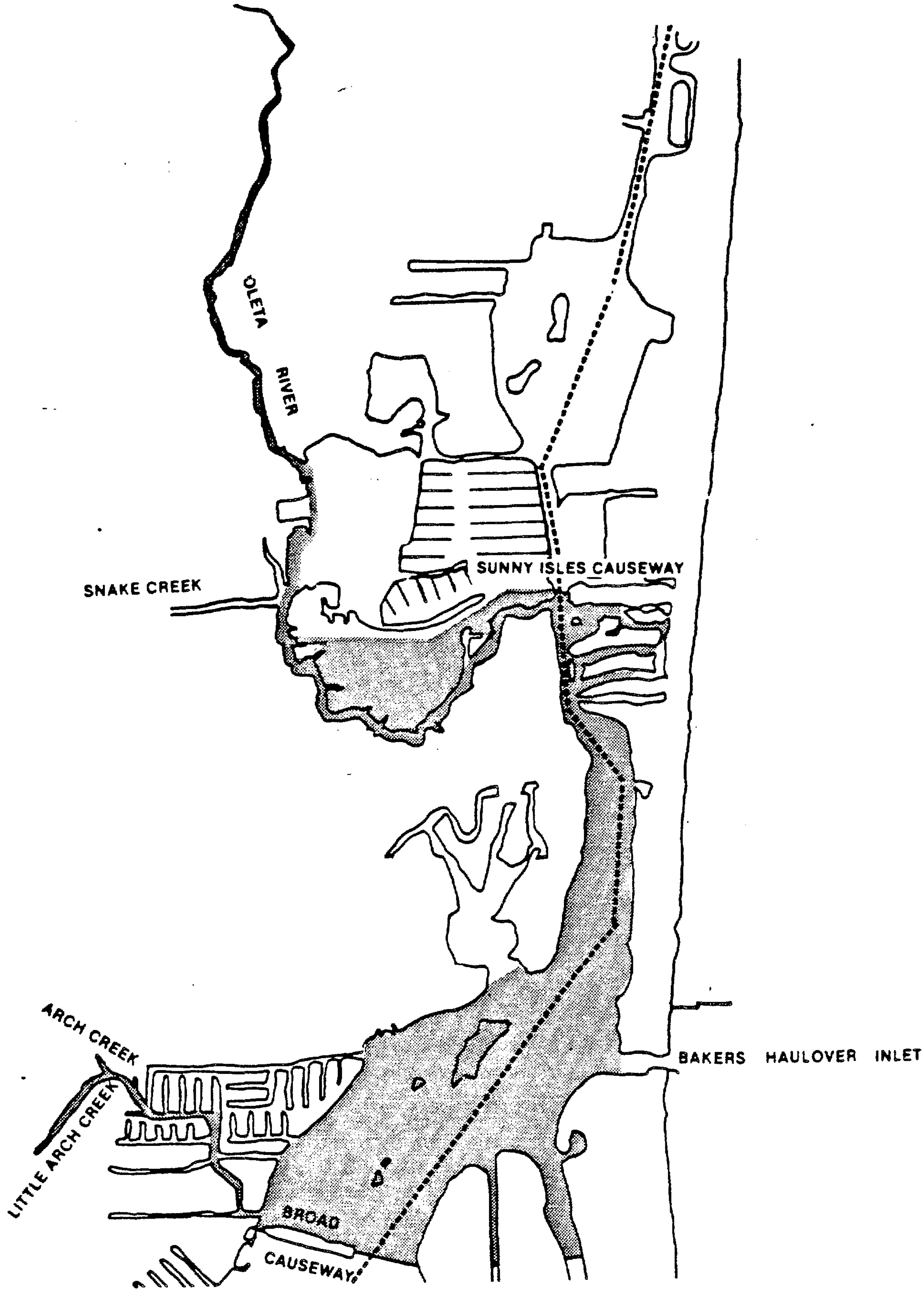
The Snake Creek Canal which discharges an average of 248 gallons per day through the S-29 structure on the west side of Maule Lake, is the major source of freshwater flowing into Unit I. Other freshwater sources are the Oleta River, Arch Creek and Little Arch Creek.

Historical Background

A State Land Survey done in 1870 (Figure 47), shows the shoreline of Unit I as lined with mangroves. In some areas (such as the tract of land known over time as the Model Land, Graves, Interama and now Oleta River State Recreation Area and FIU Bay Vista Campus) the mangrove forests appear to extend over one mile inland, but along most of the Bay shoreline the mangroves appear to be less than one-half mile wide.

In the 1870's extensive hammocks lined the banks of Big and Little Snake Creeks near the confluence of those water bodies (in the vicinity of present day Greynolds Park) about a mile and one half inland from the narrow creek that connected upper Biscayne Bay with Dumfoundling Bay. Big Snake (later renamed the Oleta River) extended about three and one half miles north. Little Snake Creek was labeled as the main passageway to the Everglades and the back route to Little River to the south and the New River to the north. There were also extensive lush hammocks lining the banks of Arch Creek in the vicinity of the famed natural bridge, a rock formation that collapsed of unknown causes in 1973. Like the Snake Creeks, Arch Creek and Little Arch Creek drained wet prairies and sloughs to the west and south until they became a part of the 'glades.

A 1914 county map (Figure 48) shows the same features as the earlier land survey. At that time mangroves lined all of the Bay area including "Island #2," later called "Miami Shores Island" and the present day Bay Harbor Islands. By 1919 the Little Snake Creek had been canalized.



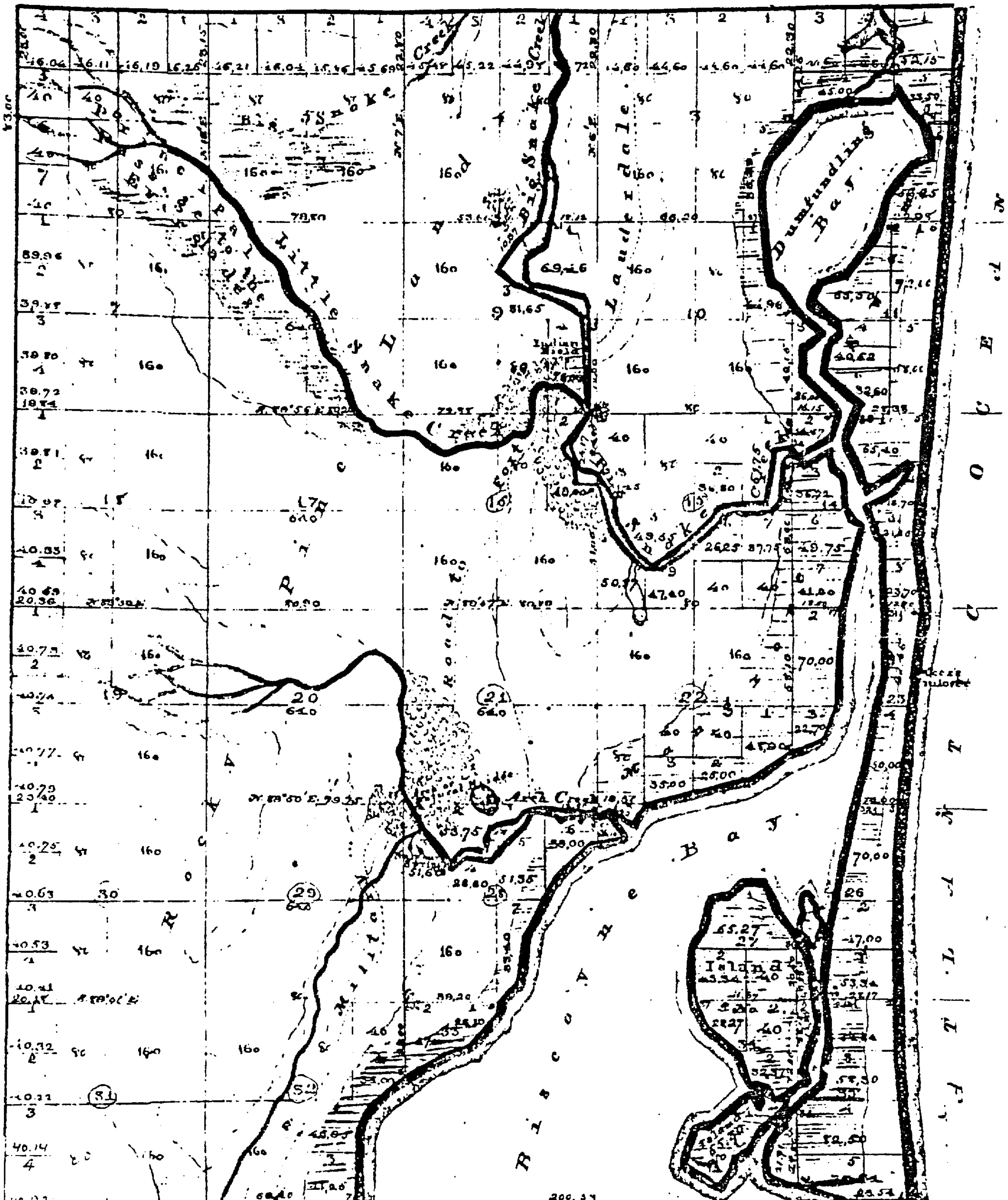
AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicaly owned parcels on islands within the Preserve.

FIGURE 46

UNIT I

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION & FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984



Total Area 14719.51 Acres.

By whom surveyed	Date of Contract	Amount of Surveys			When Surveyed
			Ch.	L.	
George McKay.	15th February 1845	4	19	60	April 1845.
M. A. Williams.	25th Feb'y 1870	4	44	27	May 6th 1870
Do	Do.	38	29	45	May 7th to 16th 1870

The above Map of Tow[...]
Meridian is stric[...]
thereof on file i[...]
approved.
Surveyor Ge[...]
Tallahasse[...]

FIGURE 47
1870 LAND SURVEY
SOURCE: PETERS, 1981

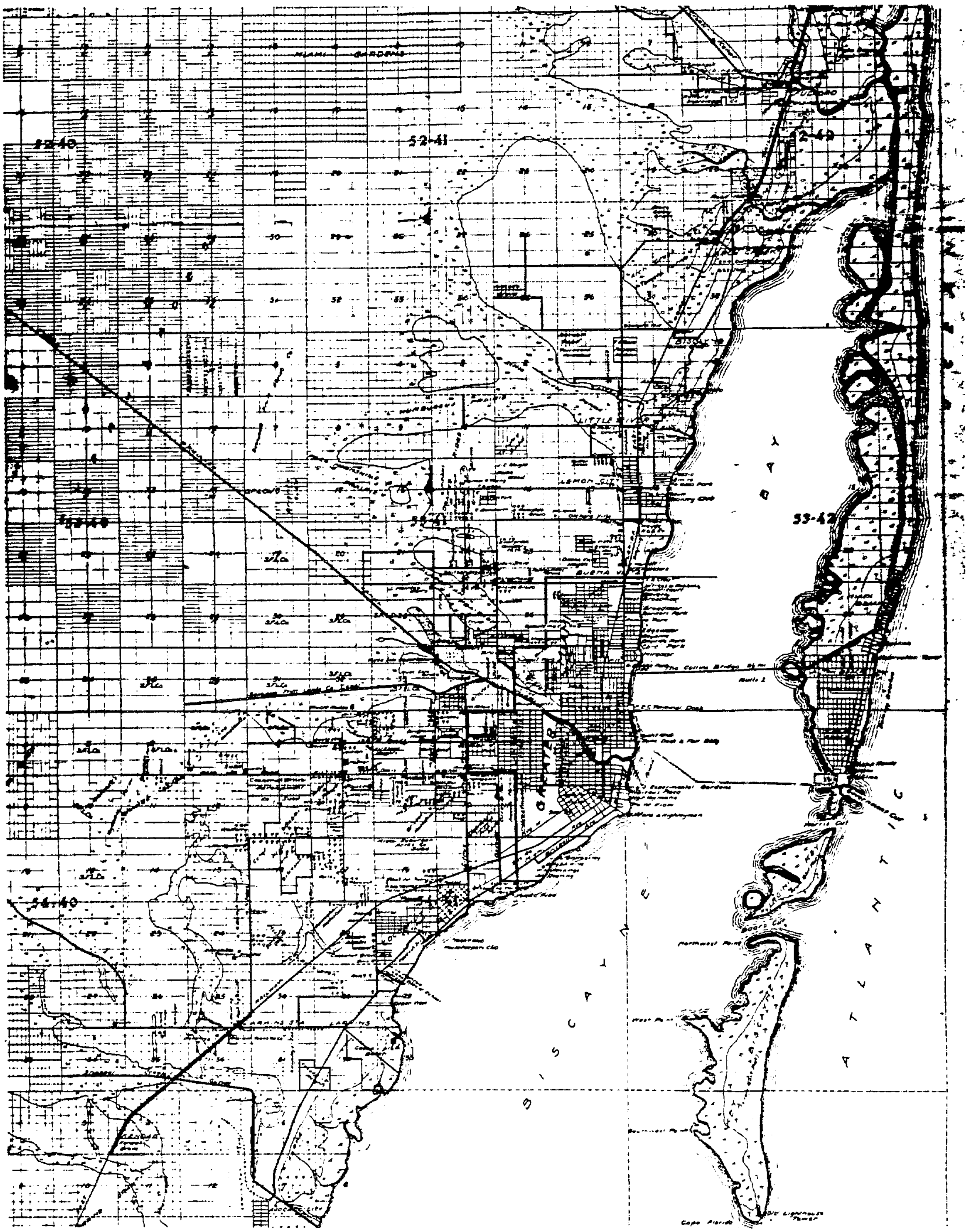


FIGURE 48

1914 LOCATION MAP OF A PORTION OF DADE COUNTY, FLORIDA

SOURCE: RICHESON LOVE, DELINEATOR
HISTORIC MUSEUM OF SOUTHERN FLORIDA MAP FILES

By 1925 Baker's Haulover Cut had been dredged and the mangroves south of Arch Creek and along most of the Bal Harbour shoreline had been cut and the area filled for land development. As noted by Peters (1981), the opening of Baker's Haulover Cut caused extensive changes in the whole north Bay area, which had been made stagnant and putrid by the filling of the County (now McArthur) Causeway in the years preceding the First World War. That situation was remedied by the opening of Haulover Cut which brought fresh Ocean water into the northern reaches of Biscayne Bay, and totally altered the chemical and circulation patterns of north Bay. As noted by Harlem (1979) within two years seagrasses were observed colonizing the formerly barren Bay bottom in Unit I.

The U.S. Coast and Geodetic Survey for 1931 (#583) shows that development had started on the southernmost island in the Sunny Isles area. By 1955 (U.S. Coast and Geodetic Survey #847) the four islands had been filled and the western half of the Keystone Point area had been dredged and filled. Also by this time Broad Causeway had been constructed and "Miami Shores Island" had been filled and bisected to become Bay Harbor Islands.

Between 1925 and 1976, 46 percent of the mangroves lining the Bay shore in the area from Haulover Park south to Broad Causeway were destroyed (Figure 49). By 1976 only four percent of the shoreline in that part of Unit I was vegetated in mangroves, mostly in areas that had been fresh water prairie in 1925 (Harlem, 1979).

Changes Since 1974

Since the passage of the Biscayne Bay Aquatic Preserve Act in 1974 several changes have occurred in and adjacent to Unit I, but their impacts have not been evaluated. Poinciana Island was bulkheaded and developed into 190 dwelling units, consisting of buildings ranging from 2-5 stories; the ramps and piers at Haulover Park were upgraded; the ICW was dredged in 1984 to remove sand that had caused shoaling problems for several years; the Bay Vista Campus of Florida International University was established and continues to expand on the old Interama property; the Munisport Dump was closed to further dumping activities but not properly sealed off; and Phase I of the 854 acre Oleta River State Recreational Area was opened in August 1986. About 40 houseboats and liveaboard boats that were docked along the Terama Tract on the Oleta River and in the Park Shore Marina in Maule Lake in 1974 had been removed by 1986.

Coastal Construction Activities. Between June 1980, when Dade County DERM began Countywide permitting of coastal construction activities, and October 1985, DERM issued over 60 coastal construction permits for private facilities in Unit I. The estimated cost for this permitted work is valued at over $1 million. Seawall/bulkhead repair or replacement accounted for approximately one-third, or $320,000 of the permitted work. In the spring of 1986 there were 10 permits pending in this unit.

During the 1980-85 period, several important public projects were also constructed in this area. These projects included an estimated $1 million to widen the 163rd Street Bridge over the Oleta River; Haulover Park marina, riprap, ramps and seawall repairs; maintenance dredging of

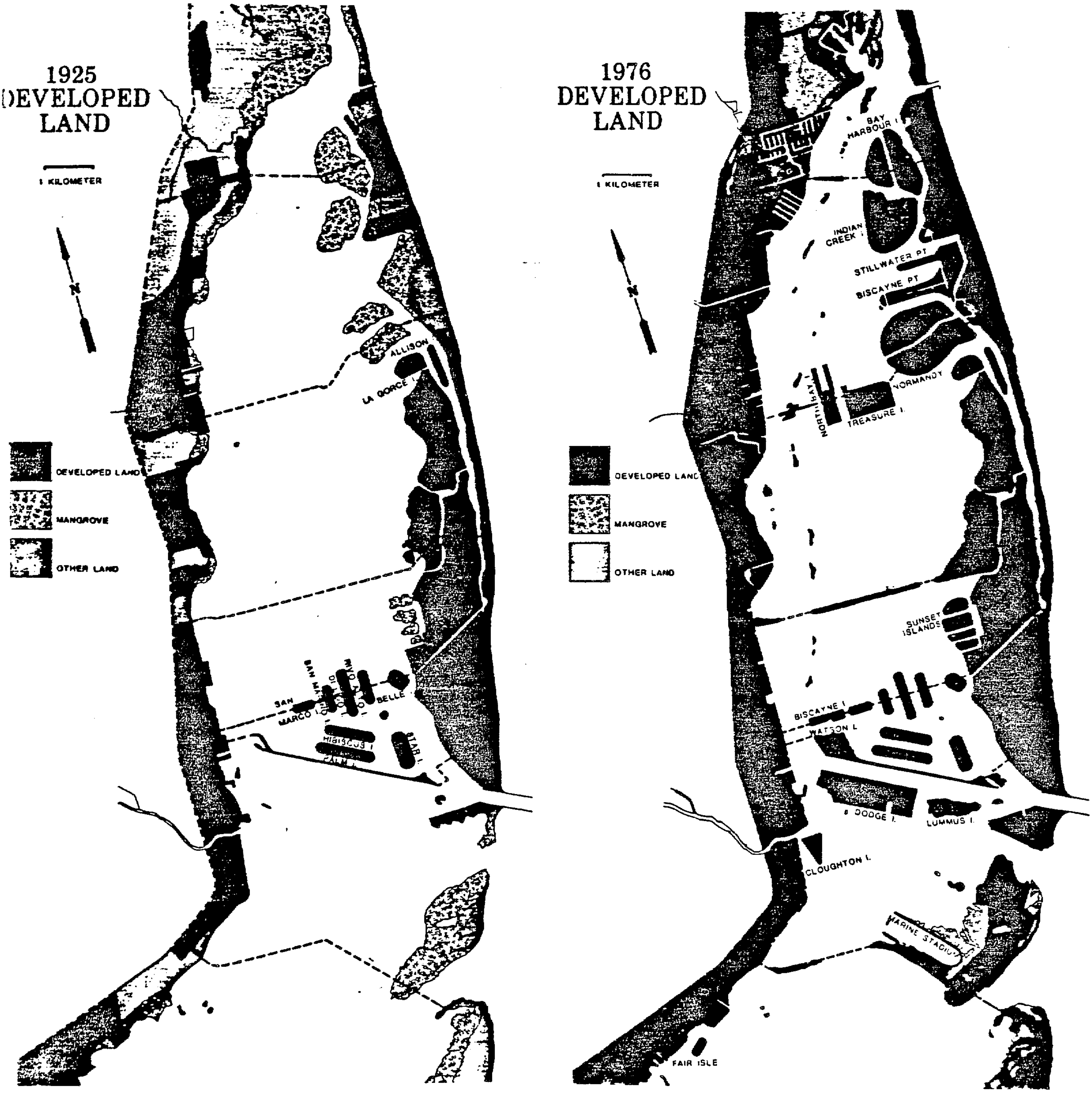


FIGURE 49

DEVELOPED LAND, 1925 & 1976

SOURCE: HARLEM, 1979

NOTE 1 KILOMETER = .6 MILE

Haulover Cut and the ICW; mangrove planting on the south side of Sunny Isles Causeway and improvements at the Oleta River State Recreational Area.

Unit I - 1986

The most noteworthy living resources in Unit I are the extensive mangrove forests that border the Oleta River and portions of the Intracoastal Waterway (ICW) north of Baker's Haulover Cut. Four hundred fifty acres, or fifty three percent of the Oleta River State Recreation Area is a mangrove preserve (see Figure 50). On the eastern side bordering the ICW there is a long narrow band of predominantly red mangroves, that is eroding.

The lower mile and one-half of the Oleta River passes through a dense mangrove forest that has been little disturbed by development, but the mangroves on exposed curves and within creek inlets are seriously eroding. As discussed in Chapter 1, mangroves were put in riprap "planters" on the south side of the Sunny Isles Causeway, in the area where the Oleta River passes directly adjacent to the widened causeway. About one year after planting, approximately 88 percent of the trees had survived (Marcus, personal communication, 1986).

As one goes north on the Oleta River, the banks are primarily developed in low density residential uses, however, for about one and one quarter miles above Greynolds Park the River is lined with mangroves and other trees. Large schools of snook, mullet and tarpon may be observed in the relatively clear, shallow water. Oysters are found on mangrove roots and pilings along the banks of this brackish river and manatees are frequently observed here in the winter months. Most of the birds that are found in the Greynolds Rookery are also observed in the mangrove trees bordering the Oleta River.

Although the banks of Arch Creek also are lined by mangroves and residences, that water body appears to provide significantly less wildlife habitat than the Oleta River. This may possibly be a result of the wide fluctuations in water levels that cause the creek to go from high water to mud flat in short periods of time (King, personal communication, 1986).

Shoreline Uses. In addition to the six and one-half miles of mangrove shoreline along the Oleta River, Greynolds Park, Haulover Park and the Oleta River State Recreation Area; the other predominant shoreline uses in Unit I are residential, park lands and marine facilities. There are approximately six miles of shoreline in Bal Harbour, Bay Harbor Island and Keystone Point that are bordered with single family homes, adjacent to vertically bulkheaded seawalls. Three miles in Bay Harbor Island and Sunny Isles areas are devoted to multifamily residential developments with vertical seawalls. In addition, there are several miles of vertically bulkheaded residential areas in Keystone Park and Sunny Isles that are just outside the boundaries of the Aquatic Preserve Management Area (see Figure 2).

In addition to the extensive vertical bulkheading along this portion of the Preserve, there are about 115 storm water outfalls greater than 12"

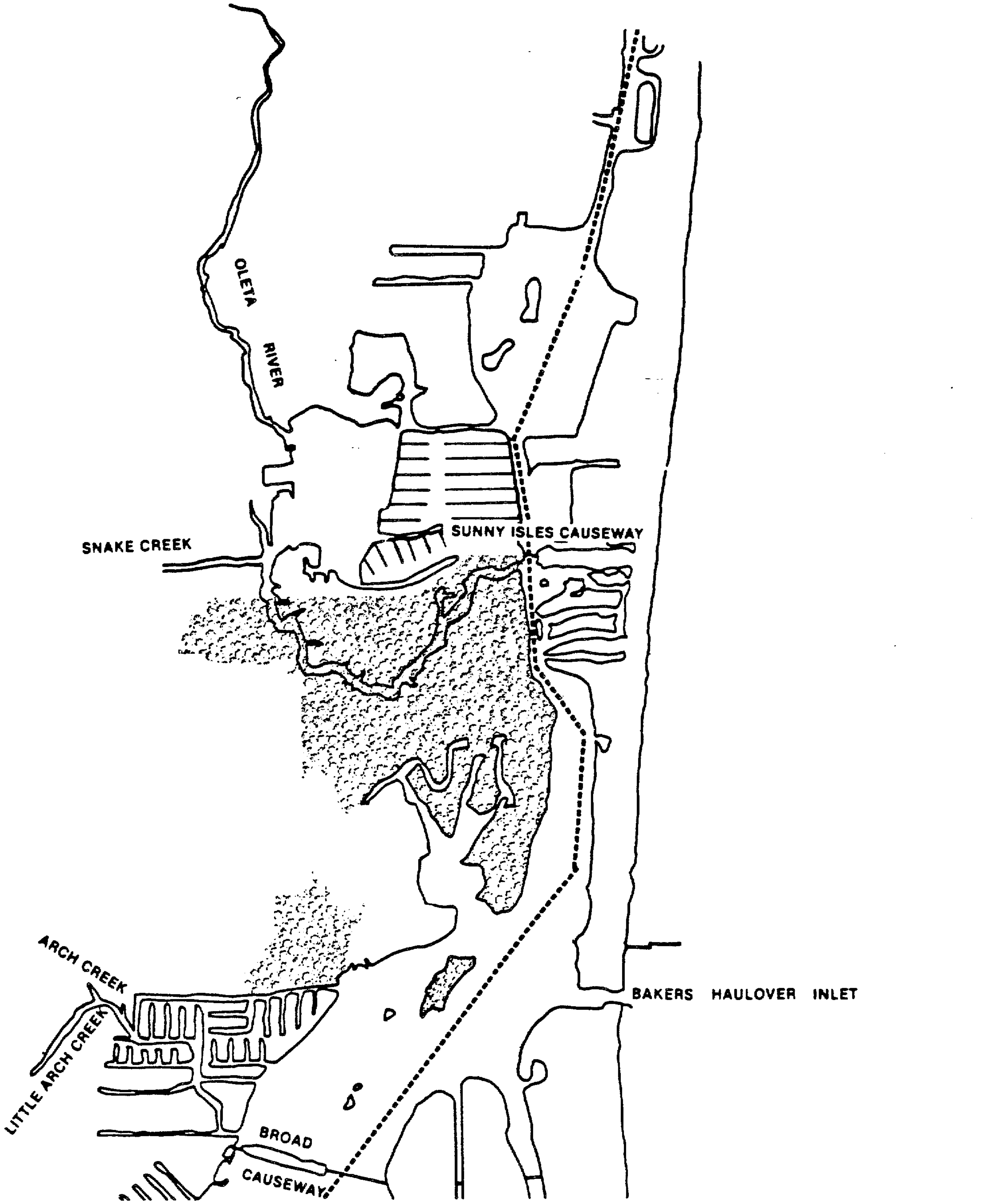


FIGURE 50

OLETA RIVER STATE RECREATIONAL AREA

SOURCE: FLORIDA DEPARTMENT OF NATURAL RESOURCES in diameter that drain into this Unit. The largest are a 66" drain into Arch Creek and a 54" drain in the Bal Harbour area (Figure 51).

Shoreline development patterns have limited public access to the waters of the Preserve in the Keystone Point, Bay Harbor Islands, Bal Harbour and the Sunny Isles areas. However, the limited public access is offset by the presence of three large public parks and the Broad Causeway.

Approximately nine miles of publicly owned land border Unit I. Haulover Park provides wet slips, boat ramps, fishing charters, and picnicking facilities along the Bay/ICW. From the Haulover jetty, shoreline anglers fish for snook and tarpon. At Greynolds Park canoe trips are run on the Oleta River and a fishing boardwalk, mostly used by local residents is located in East Greynolds. A planned canoe launch/dock and artificial reef in East Greynolds Park will provide additional public access to the Oleta River area for birding, fishing, and other activities that are compatible with the Preserve Area. The City of Bay Harbor Islands maintains a 150 foot fishing pier on the eastern end of the Broad Causeway, but it is only open to residents of the town.

The Oleta River State Recreation Area has the potential to provide a substantial amount of physical and visual access to the Preserve. The first phase of work included clearing, paving and landscaping of about 90 acres of this 854 acre area at a cost of approximately $3.2 million. Attractive wooden picnic shelters and restrooms were constructed and a swimming beach will be constructed in an inlet near the mouth of the basin. The Florida State Department of Natural Resources has asked the Florida Legislature for additional funds to stabilize part of the eroding shoreline along the ICW and to finish some of the landscaping. The FDNR and FIU are developing long range plans for some of the remaining three hundred upland acres at this site.

In-Water Activities. Figure 52 indicates the in-water activities which take place in this unit. From Sunny Isles Causeway south, the ICW provides a direct route to Dumfoundling Bay and Broward County to the north, and the rest of Biscayne Bay to the south. Baker's Haulover Inlet (or Cut) provides direct access to the Atlantic Ocean, however, the number and types of boats using Haulover Cut are limited by the low (32') vertical bridge clearance. Also, oftentimes the combination of tidal currents and winds create treacherous conditions in the Cut, further limiting the number of boats that can gain access to the Atlantic Ocean. At the southernmost limits of Unit I, most boaters use the ICW through the Broad Causeway since there is only minimal clearance under the bridges at Indian Creek, between the Bay Harbor Islands, and between the mainland and the Broad Causeway.

Haulover Cut and its attendant Bay navigational channels have a tendency to shoal. In 1985, the US Army Corps of Engineers redredged these navigation channels and deposited the sand back on the beach north of Haulover Cut. A longer jetty, currently under construction, should help to alleviate this situation.

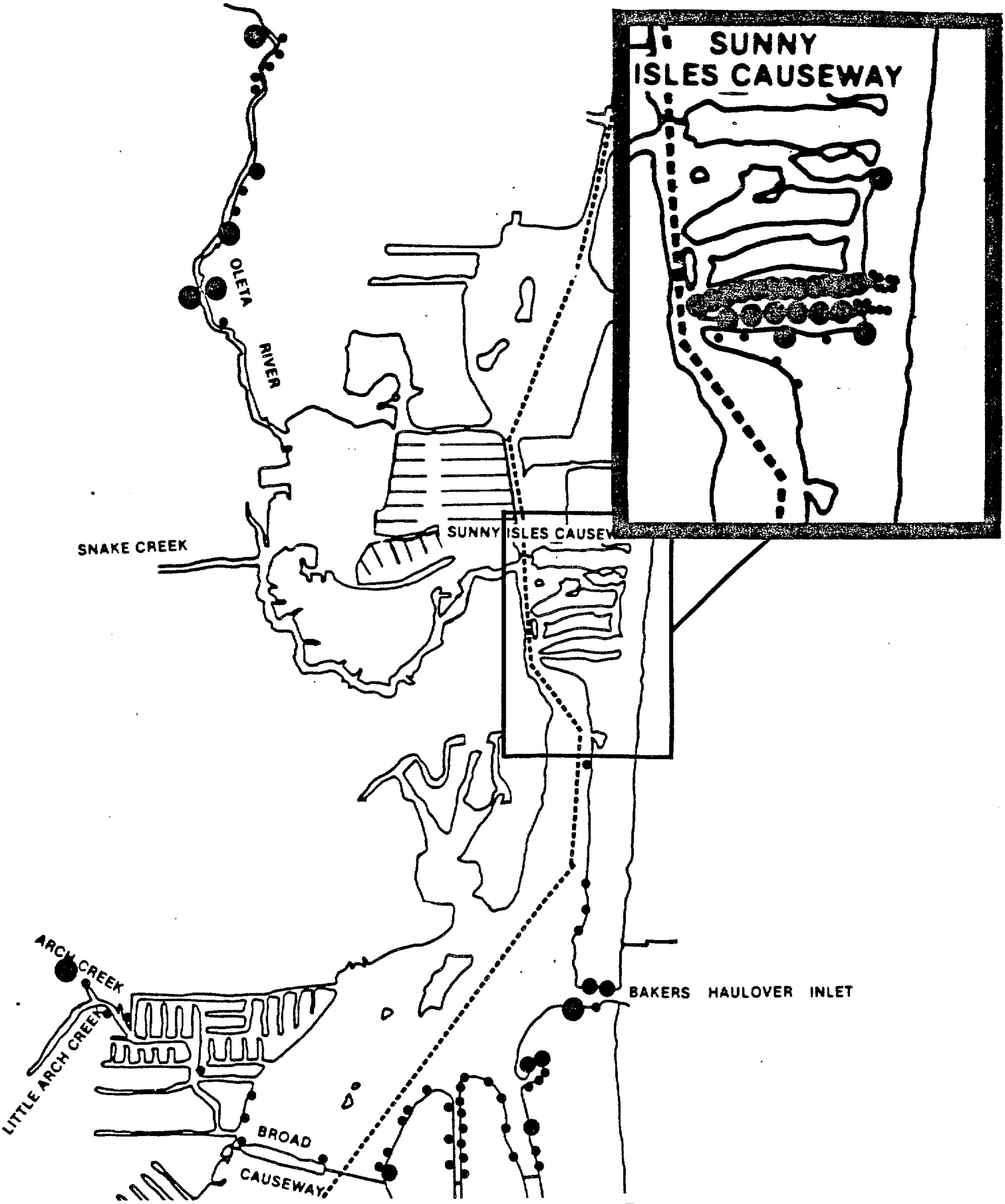


FIGURE 51

STORM WATER OUTFALLS

- ≥ 30"
- 24-30"
- 12-23"

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

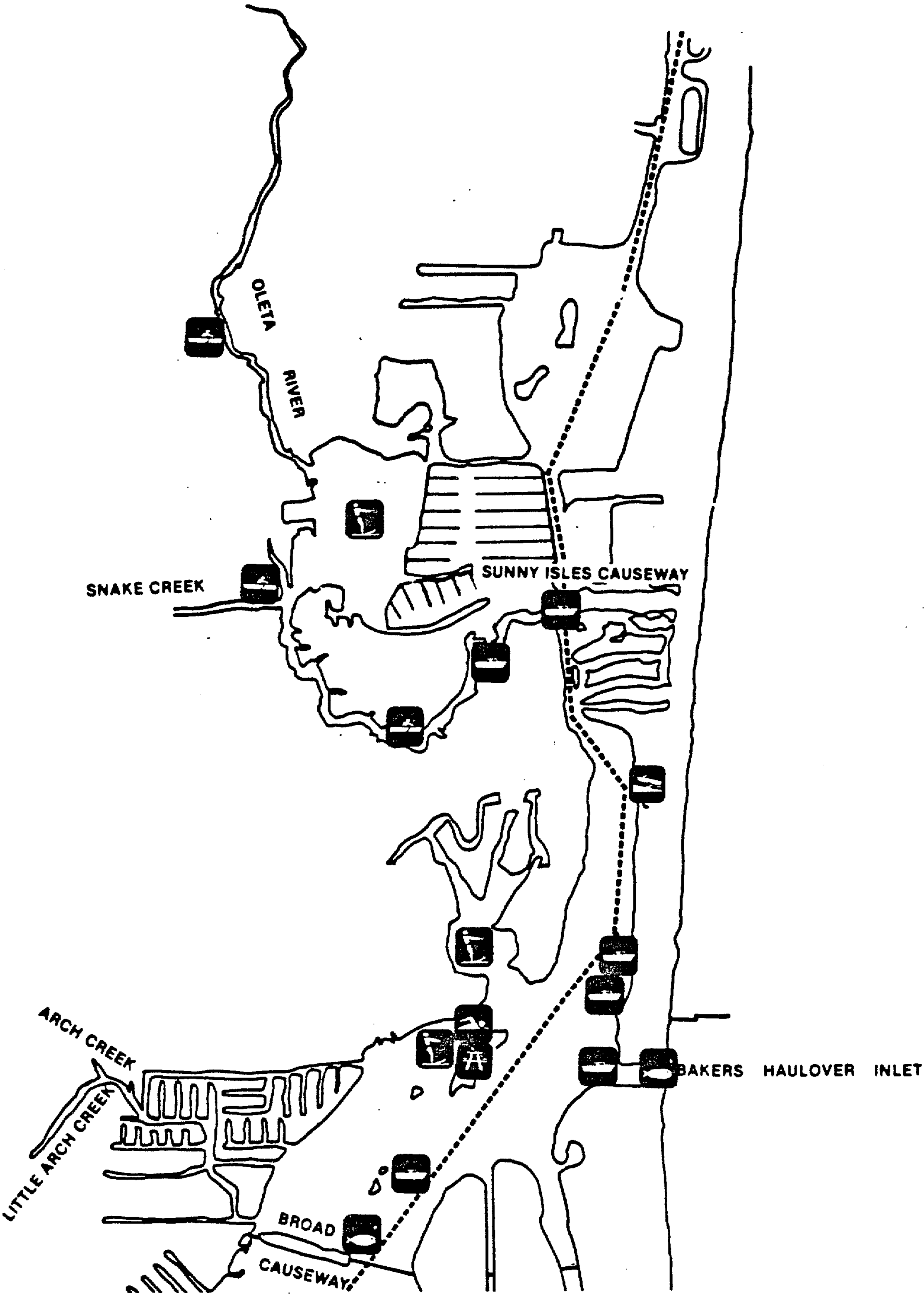


FIGURE 52

IN-WATER ACTIVITIES

SOURCE: METRO-DADE PLANNING DEPT., 1986

A number of boating and boating-related activities take place within this unit. The Oleta River is used for canoeing, fishing, birding, waterskiing and motorboating. The large spoil island known locally as "Sandspur Island" just south of the Oleta River State Recreational Area is used by boaters for picnicking. Waterskiing and swimming take place on the lee side of the island. Water skiers also utilize the large basin within the Oleta River State Recreational Area and Maule Lake.

Several boating accidents have occurred at the confluence of the Oleta River and the ICW. Based on Florida DNR statistics, this intersection was the scene of three accidents, which caused eight injuries during 1985 (see Figure 45). South of the Sunny Isles Causeway, the ICW traverses a long narrow passage to Haulover Cut. Heavy boat traffic causes severe wave/wake conditions that make this one of the most dangerous areas in the entire Preserve. In 1984, a serious boating accident also occurred at the southern end of the unit at the eastern edge of the submerged row of pilings offshore from NE 123 Street.

Twenty-two marinas with more than ten slips provide 689 wet and 1,125 - 1,175 dry slips in and adjacent to Unit I (Figure 53). Eleven of these facilities are in Dumfoundling Bay, Little Maule Lake and Keystone Point, outside of the APMA. As shown in Table 15, the occupancy rate for the facilities within Unit I was approximately 73 percent in 1986 while the occupancy rate for the facilities just outside Unit I was estimated to be 77 percent. An additional 75 boats were observed to be docked at bulkheads adjacent to private residences in aerial photographs taken in February 1986.

Submerged Lands. Limited available data on submerged land conveyances in Unit I indicate that most of the 3.5 square miles of Bay bottom in this area has been retained in State ownership (Figure 54). Only the Haulover Cut channel, the western edge of Maule Lake and the Kings Point area in Sunny Isles appears to have been transferred from State ownership, although large spoil easement areas are indicated adjacent to the Oleta River State Recreation Area (see Figure 41).

Use of submerged lands within Unit I is not only governed by sovereignty ownership and Federal, State and County coastal construction regulations, but also by City of North Miami's jurisdiction over the western half of this unit; by the City of North Miami Beach's jurisdiction over the Oleta River area from Sunny Isles north to NE 175 Street; and by Bal Harbour's jurisdiction in Indian Creek and offshore of Bal Bay Drive. These municipalities can control activities and construction both on the shoreline and within the water areas that are under their respective jurisdictions. The Town of Bay Harbor Islands borders this unit, but its area of jurisdiction is limited to the immediate shoreline and the Bay Harbor Waterway (Figure 55).

This unit is underlain with cables, channels, pilings and submerged vessels. A submerged wreck is visible at the northwestern edge of Maule Lake. Major utility crossings occur at the Sunny Isles Causeway and in Haulover Park. A marked channel provides access west and north from the ICW into the north entrance to Keystone Point ("Arch Creek North"). A

TABLE 15

MARINA FACILITIES WITH MORE THAN TEN SLIPS IN UNIT I

No.	Type	Address/Name	Number of Wet Slips	Number of Dry Slips
1	Commercial	17501 Biscayne Boulevard "Jerico"		75
2	Commercial	17201 Biscayne Boulevard "Maule Lake Marina"	134	130+ surface storage
3	Commercial	2500 N.E. 163 Street "Blue Marlin Fisheries"	10	
4	Commercial	Sunny Isles Causeway	18	
5	Commercial	400 Sunny Isles Causeway "Sunny Isles Marina"	18	20+
6	Condominium	400 Kings Point Drive "Coastal Towers"	33	
7	Public	10880 Collins Avenue "Haulover Park"	44	
8	Private	200 Bal Bay Drive "Bal Harbor Yacht Club	37	
9	Condominium	Ixora Court, North Miami "Keystone Point Condo"	14	
10	Condominium	13255 Biscayne Boulevard "Biscayne Marine"	15	75
11	Condo/Apt.	13201 Biscayne Boulevard	10	
Total			333	300
Estimated occupancy = 73 Percent*				

*Based on aerial photographs taken in February, 1986, and allowing for a 10 percent vacancy rate.

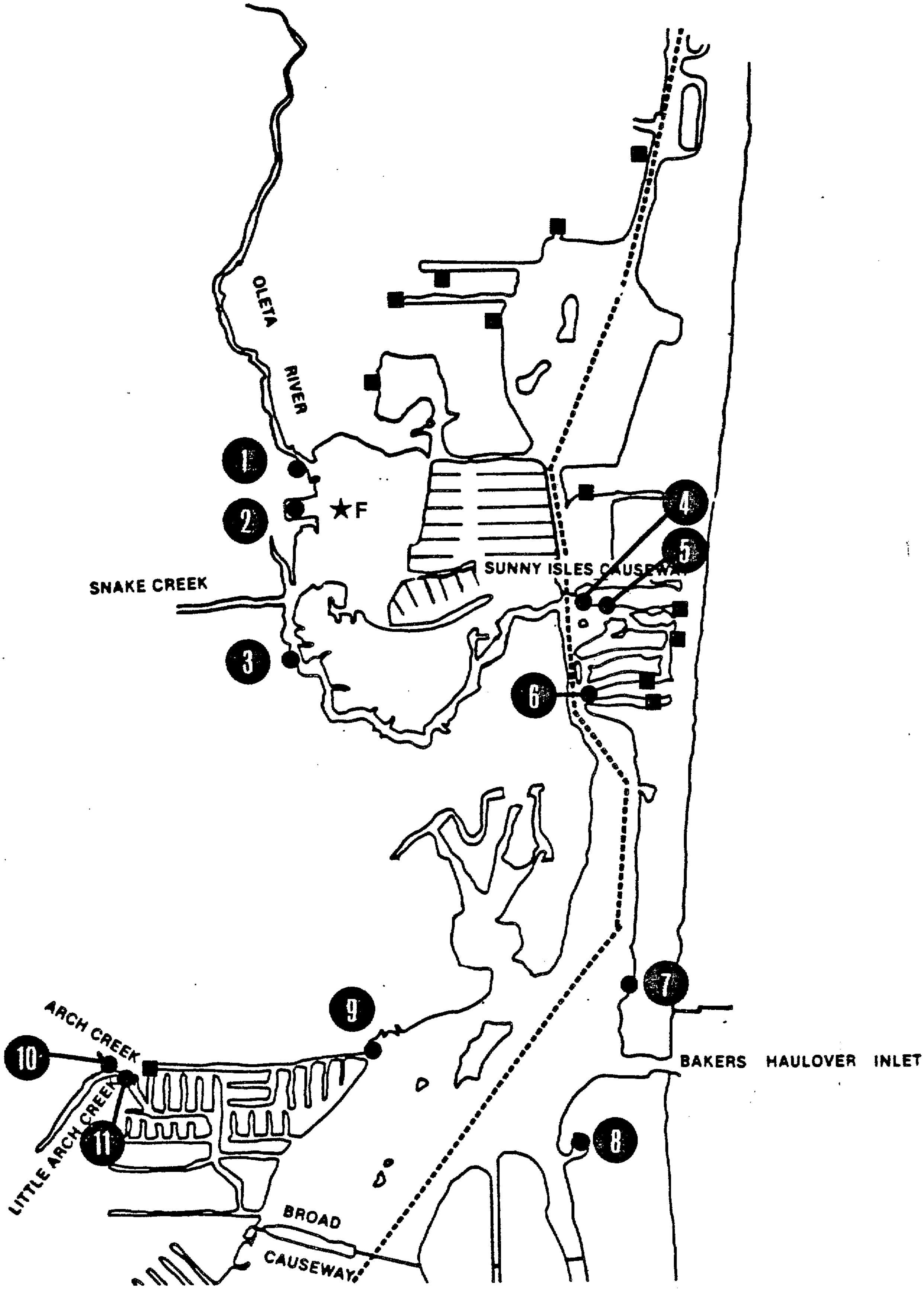


FIGURE 53

MARINA LOCATIONS

- ● WITHIN APMA
- ■ ADJACENT TO APMA
- ★ ANCHORAGE AREAS

SOURCE: METRO-DADE PLANNING DEPARTMENT, 1986

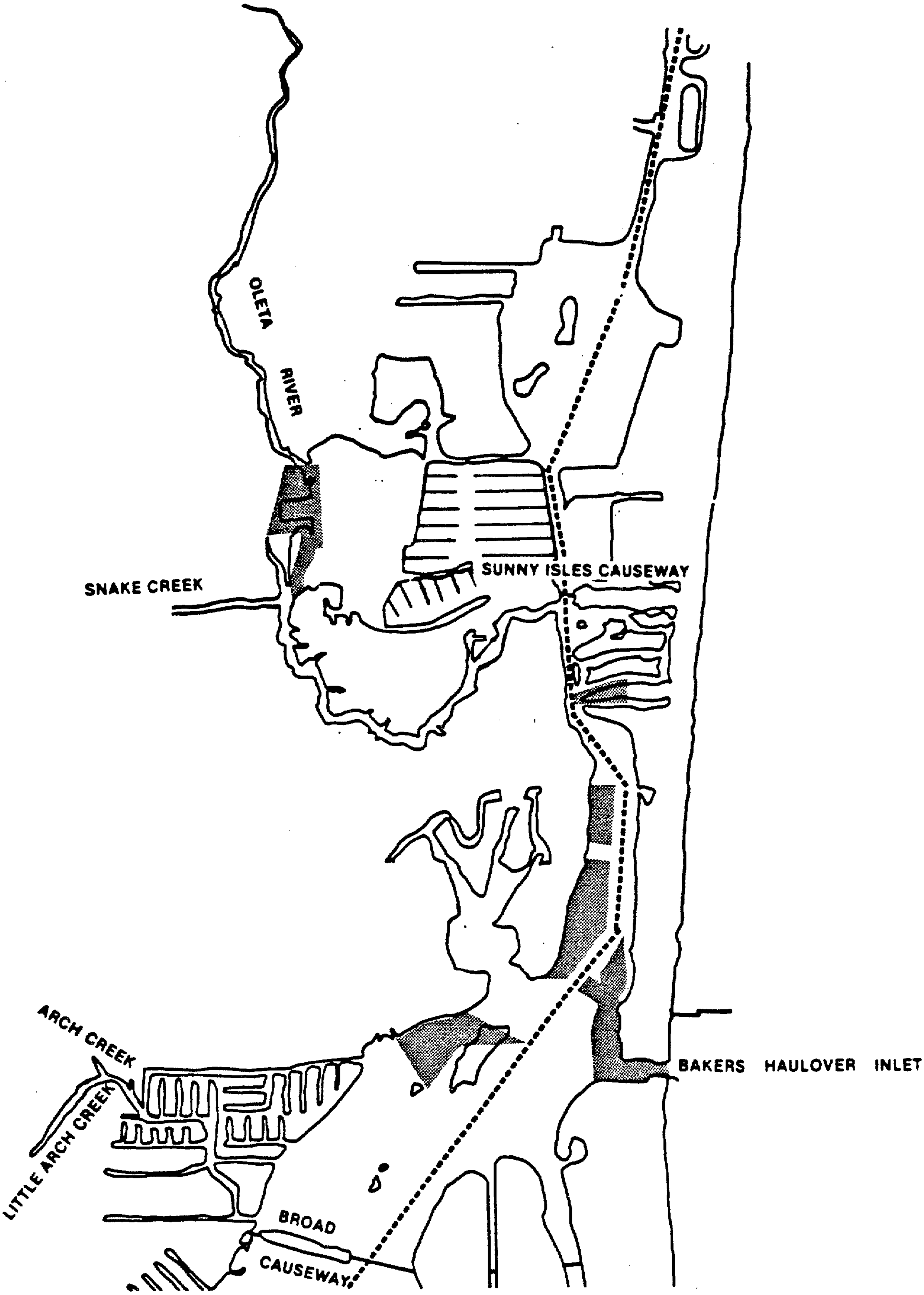


FIGURE 54

SUBMERGED LAND CONVEYANCES

SOURCE: FLORIDA DEPARTMENT OF NATURAL RESOURCES

NOTE: THIS INFORMATION HAS NOT BEEN REVERIFIED DURING THIS PLANNING PROJECT BY FDNR

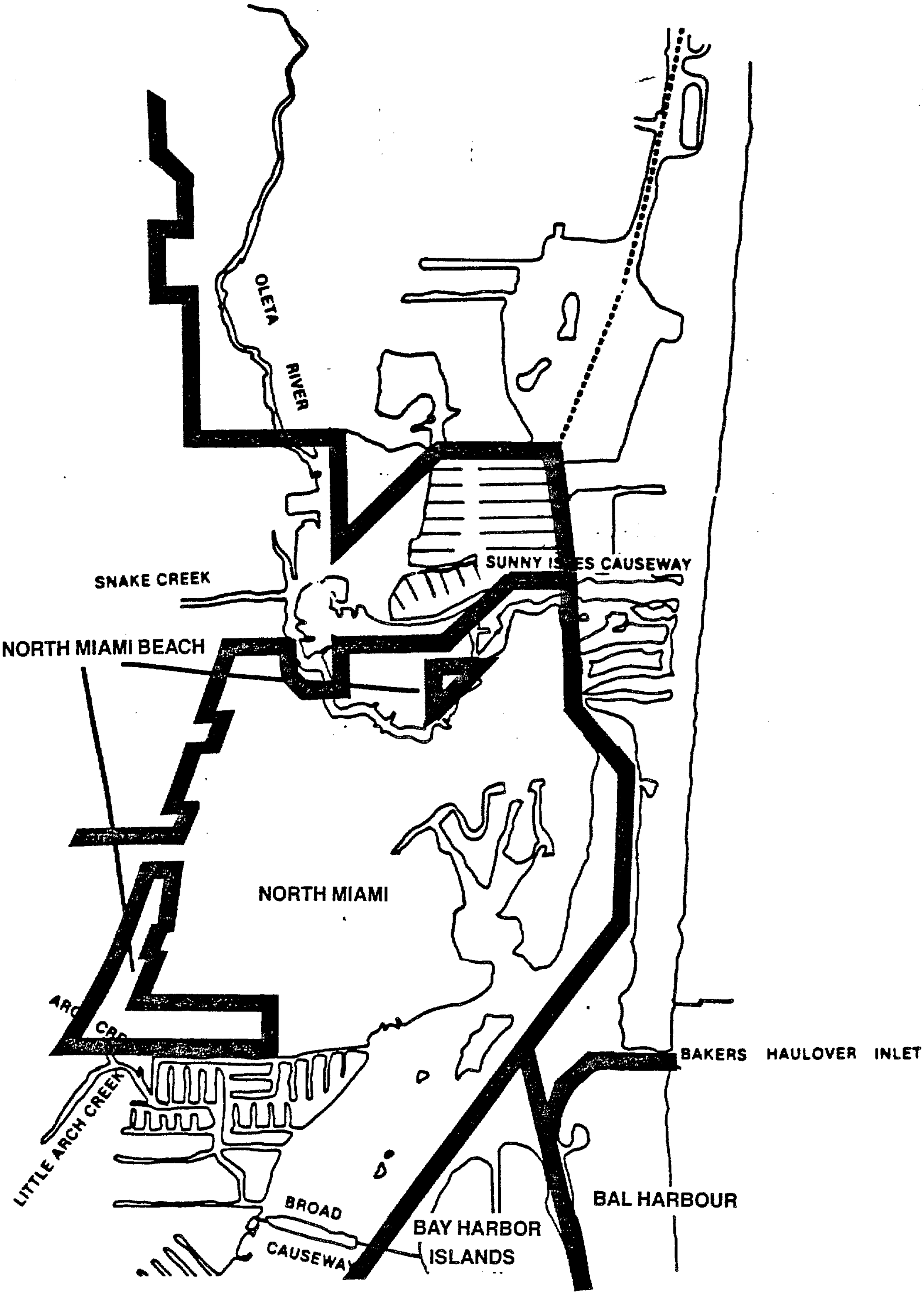


FIGURE 55
MUNICIPAL JURISDICTIONS
SOURCE: METRO-DADE PUBLIC WORKS DEPARTMENT, 1983

row of submerged pilings, located about 250 yards west of the ICW, runs almost 750 yards in a westerly direction towards the south entrance to Keystone Point ("Arch Creek South").

UNIT I

MANAGEMENT OPPORTUNITIES

Figure 56 indicates the major opportunity sites within Unit I. The recommendations presented below relate to upgrading water quality, conserving natural resources, providing public access and improving public safety within this area. The numbers correspond to the ones shown on Figure 56.

Water Quality

1. Storm Water Outfalls. From the standpoint of size alone, two outfalls should receive priority for phasing out, or redesign to minimize the negative impacts of the first one inch of runoff on the waters of the Preserve: a 66" drain into Arch Creek and a 54" drain in the Bal Harbour area. There are more than 100 outfalls greater than 12' in diameter that empty into Unit I (see Figure 51). Those that drain large areas of heavily traveled roadways should receive priority for retrofitting if they are not already scheduled to be upgraded as part of planned roadway improvements.

2. Heavy Metals. The high levels of chromium, cadmium, copper, zinc and lead in oysters in and adjacent to Unit I are indications of pollution. Possible sources include storm water runoff and boat bottom paints. The sources and impacts of pollution should be identified.

Resource Conservation

3. Mangroves. Because of boat wakes along the narrow ICW and within the Oleta River, mangroves are deteriorating and falling in the water. An idle speed/no wake zone should be established for the area north of Haulover Cut. The Oleta River south of Sunny Isles should also be made an idle speed/no wake zone in order to protect the valuable mangrove communities that remain.

4. Shoreline Stabilization A shoreline stabilization project should be undertaken in the mangrove area along the eastern edge of the Oleta River State Preserve adjacent to the ICW.

5. Broad Causeway. The City of Bay Harbor Islands should cover the rubble edge of the Causeway with riprap boulders.

Public Access

6. Oleta River State Recreational Area. If water skiing is to continue to be allowed within the basin area (which is outside the Aquatic Preserve), then the basin should not be used as a moorage area. If water skiing is found to be incompatible with the use of the new swimming beach, then moorage should be encouraged in this well sheltered area.

7. Waterborne Transportation. The Oleta River Recreational Area should be linked to Haulover Park and to "Sandspur" Island utilizing a waterborne transportation network.

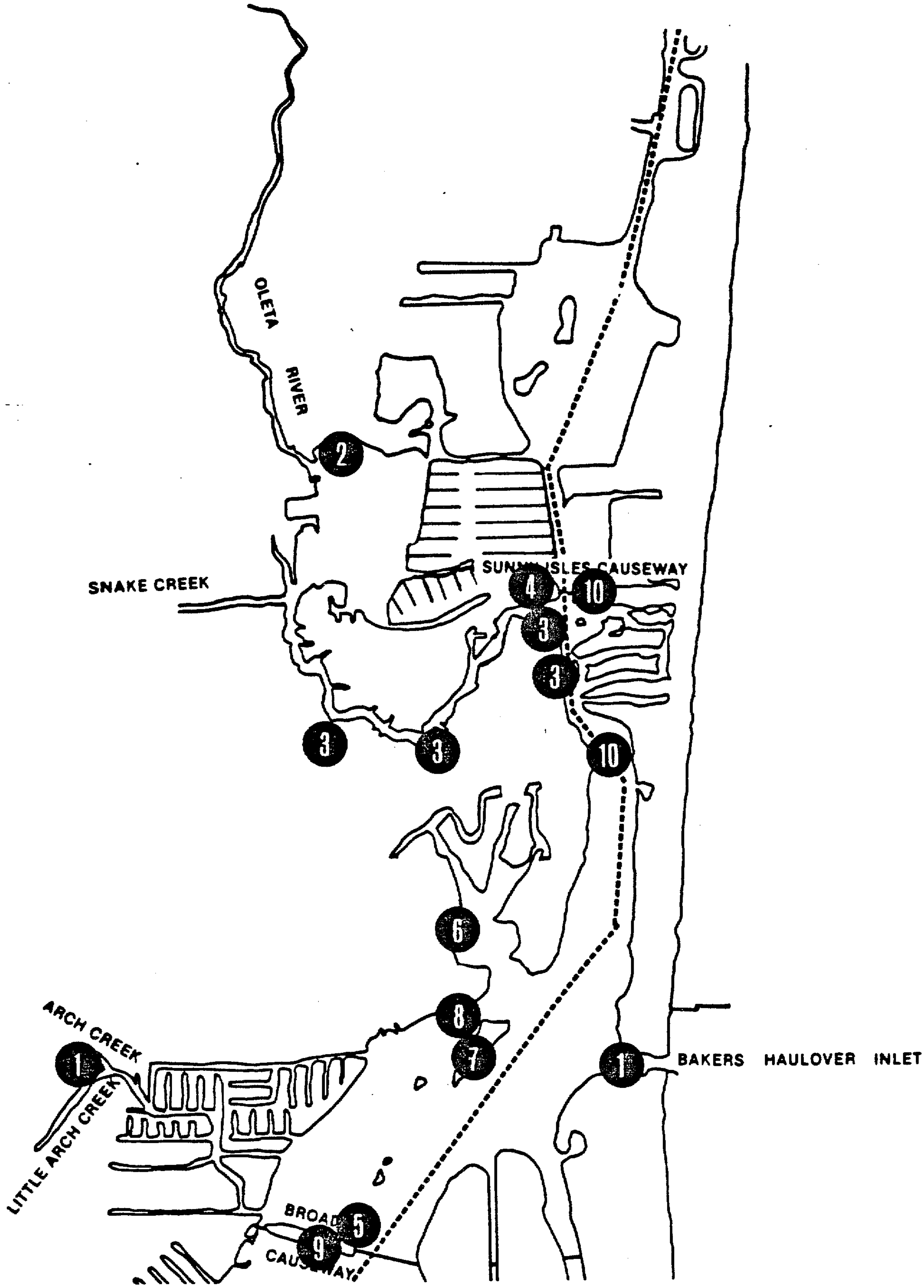


FIGURE 56
MANAGEMENT OPPORTUNITIES UNIT I

8. <u>Sandspur Island</u>. Any improvements to this site should be compatible with the traditional uses of this island for picnicking. The waters on the lee side of the island should continue to be used for water skiing.

9. <u>Broad Causeway</u>. In its redesign of the Causeway, the Town of Bay Harbor Islands should seek to maximize public visual and physical access to the Bay and to buffer the incompatible shoreline uses from public view.

Public Safety

10. <u>Boating Safety</u>. The confluence of the Oleta River and the ICW is an extremely dangerous intersection for boaters. As recommended above, this area should be a posted and strictly enforced with idle speed/ no wake zone.

ID# 1090/na

CHAPTER 3

UNIT II

Broad Causeway to 79th Street Causeway

Introduction

The 4.8 square miles of water area in Unit II is bordered by the Broad Causeway and Bay Harbor Islands on the north; by Surfside and the City of Miami Beach on the east; by the 79th Street Causeway and North Bay Village on the south; and by the City of Miami, unincorporated Metropolitan Dade County, Miami Shores and North Miami on the mainland from NE 79th Street to NE 132nd Street on the west.

The Preserve Area within Unit II includes the Indian Creek and Indian Creek Lake, the Tatum Waterway and the Normandy Waterway and all of the publicly owned uplands on islands within the area described. The Preserve does not include Point Lake in Surfside, the canal in Biscayne Point or any of the man-made waterways on the mainland shore including Biscayne Canal (Figure 57).

This area is bordered by 25 linear miles of shoreline which is 83 percent bulkheaded (see Figure 18). Water depths vary from 20 feet to one foot at mean low tide with average depths of about six feet (see Figure 14). Fifty percent of this area has been dredged and an additional 32 percent is naturally barren. Only about 270 acres, or eight percent of the bottom is vegetated (see Figure 32). As discussed in Chapter I, the relative paucity of submerged vegetation is reflected in the types and number of bottom dwelling organisms and fish and shellfish found in this area.

North Bay's tidal current nodal point - the point where tides coming in Baker's Haulover Cut meet the tides coming in from Government Cut - is located in the center of Unit II. As a result tidal currents are extremely small and there are particularly poor flow conditions in this unit (Wang and Van de Kreeke, 1984). As discussed in Chapter 1, the residence time within Unit II ranges from 5.5 days north of the nodal point to 13.2 days south of the nodal point (Van de Kreeke and Wang, 1984).

As noted by Wanless (1984), there are generally high average levels of turbidity on the eastern side of Unit II near the nodal point. The lack of seagrass beds exacerbates turbidity levels in Unit II. Also, more than eleven miles of dredged channels and holes, and submerged spoil banks add particulates and turbidity to this Unit.

The Biscayne Canal discharges a relatively small amount of freshwater into this unit. According to United States Geological Survey records, the average amount of flow through the S-28 structure at 107th Street is 67 million gallons per day. This is lower than any of the other outflows into north Biscayne Bay from canals that are controlled by the South Florida Water Management District (Heath and Conover, 1981).

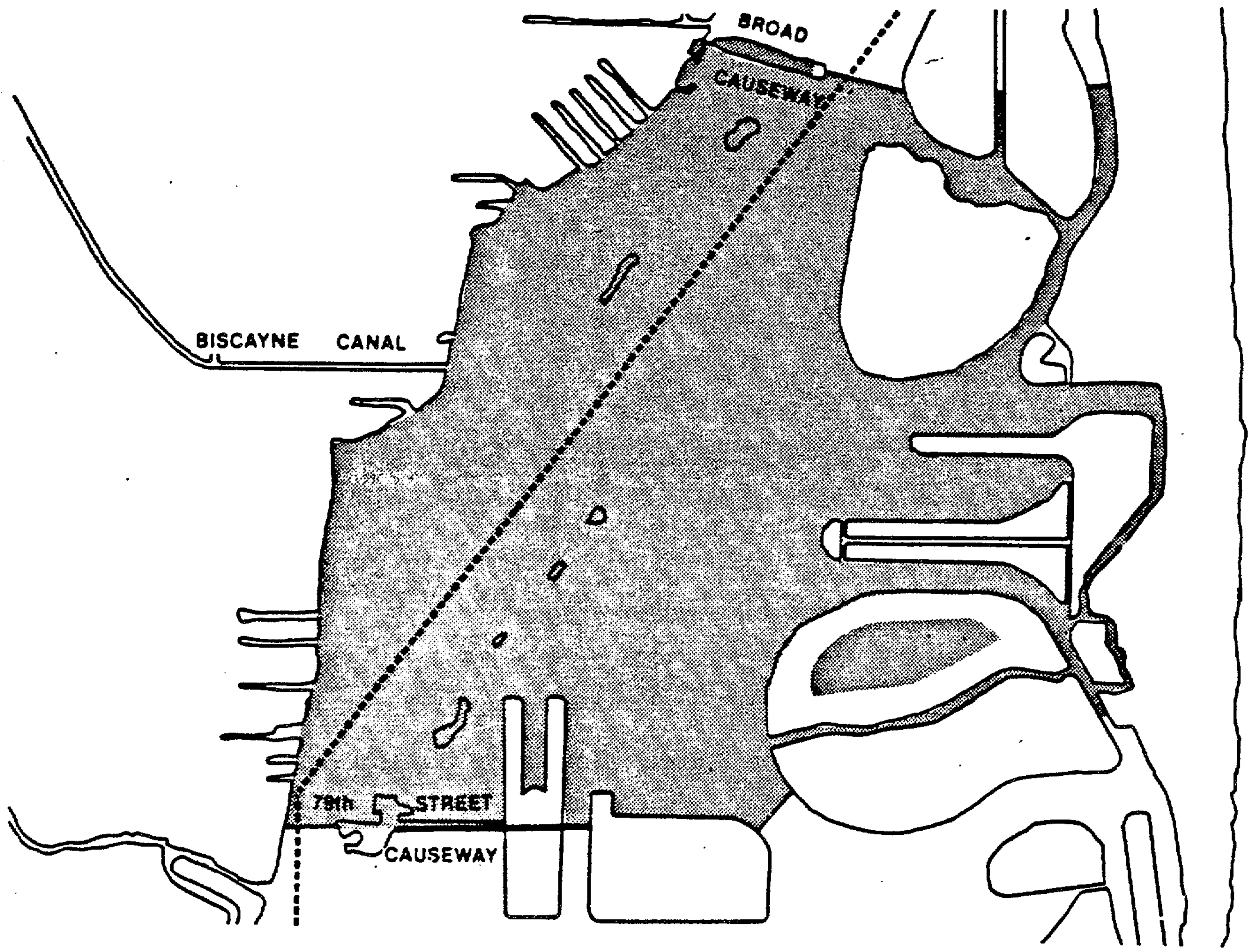
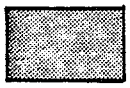


FIGURE 57
UNIT II

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984



AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

Water also flows into Unit II from more than 140 storm water outfalls (Figure 58). The largest of these is located on the western side of Harbor Island in North Bay Village.

Historical Background

In the early 1920's Unit II's shoreline consisted of a thin band of mangrove swamps along the mainland and a dense mangrove forest along the eastern shore (Harlem, 1979). On the U.S. Coast and Geodetic Survey map dated 1928 (Figure 59), the Surfside, Bay Harbor Islands and Indian Creek areas were referred to as Miami Shores and were shown as mangrove swamp. On this same map, the mainland shore still consisted of a narrow band of mangroves.

As noted earlier, the opening of Haulover Cut in 1925 caused extensive alterations to the north Bay area (Harlem, 1979 and Peters, 1981). Prior to the 1925 opening, only one per cent of the Bay bottom in Unit II had any visible plant vegetation. By 1928, benthic vegetation had increased, especially along the large undisturbed expanses of shallows in the eastern half of Unit II.

Dredge and fill activities from the late 1920's through the 1950's, within Unit II drastically changed the shoreline configuration, water depths and the amount of open water. According to the 1887 U.S. Coast and Survey map, the deepest natural area in north Bay occurred just north of the present-day 79th Street Causeway; but much of the remaining area was very shallow. After 1928, dredging in the eastern portion of the Bay to fill Miami Beach destroyed the shallows and eliminated much of the grass and algal beds (Harlem, 1979).

From the late 1920's through the 1950's several major dredging and filling operations were done in and adjacent to this area. In July 1928 the two lane 79th Street Causeway was completed and opened to traffic. The 1928 U.S. Coast and Geodetic Survey map of this area showed Surfside as laid out in a grid street pattern and Biscayne Point and Normandy Isles as filled. Streets were shown on Biscayne Point and the southern of the Normandy Islands. By 1931 the Bay Harbor and Indian Creek Islands had been filled (U.S. Coast and Geodetic Survey map #583). By 1941 roads were laid on Indian Creek Island (Figure 60). In 1949, both Stillwater Point and Harbor Island (the north portion of North Bay Island) appear on the official County map (Figure 61). Broad Causeway was completed and opened in 1957 (Harlem, 1979) and in 1972-73 the old two lane 79th Street Causeway was expanded to four lanes.

In summary, the expansion and creation of the islands and land area within Unit II increased the shoreline length by over 90 percent. The water area within Unit II was reduced by 25 percent (Harlem, 1979).

Changes Since 1974

Since 1974 there have been relatively few changes in land uses in or adjacent to Unit II. A few single family homes and small docks have been built. The most notable private developments were the construction

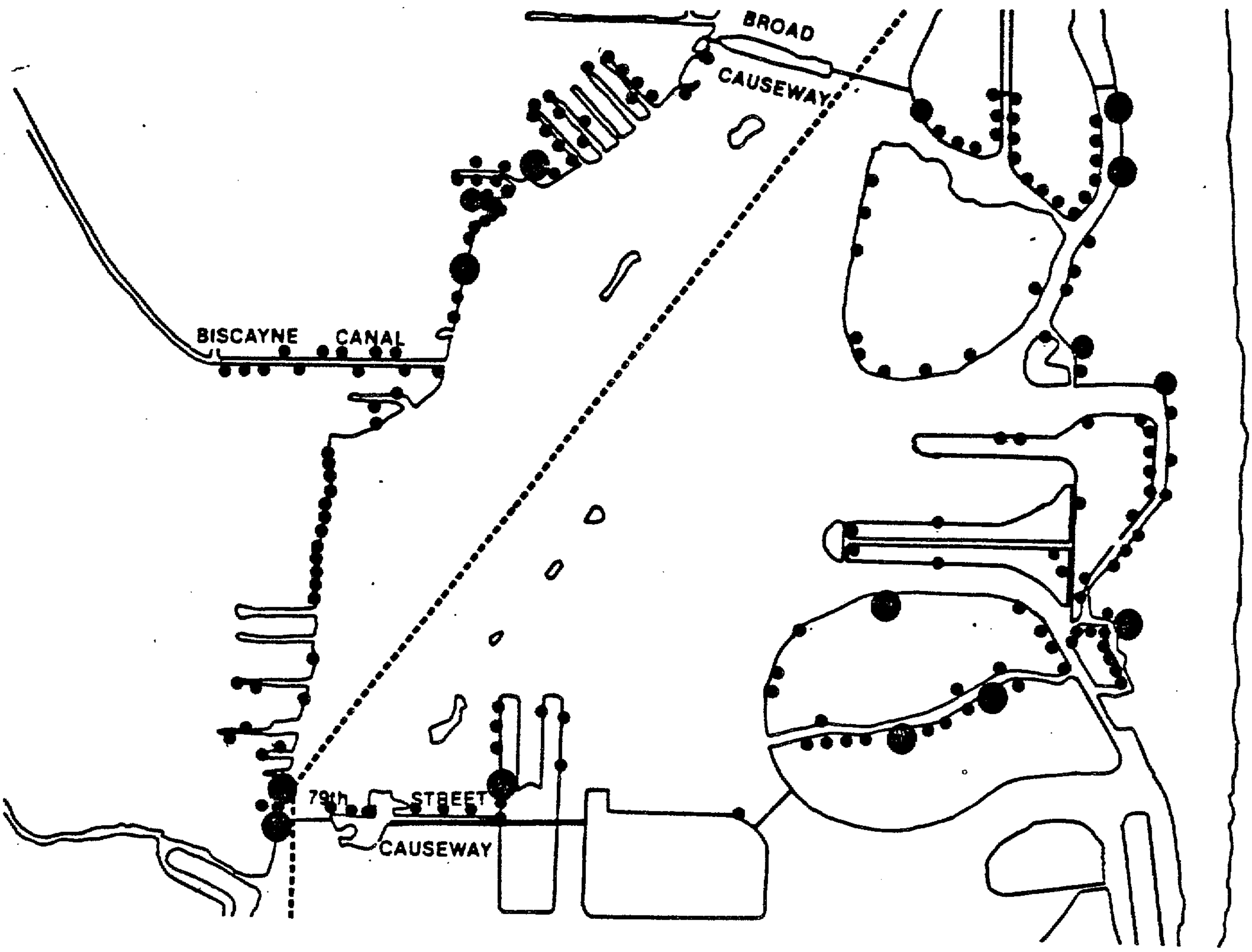


FIGURE 58

STORM WATER OUTFALLS

● ≥30″
● 24-30″
• 12-23″

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

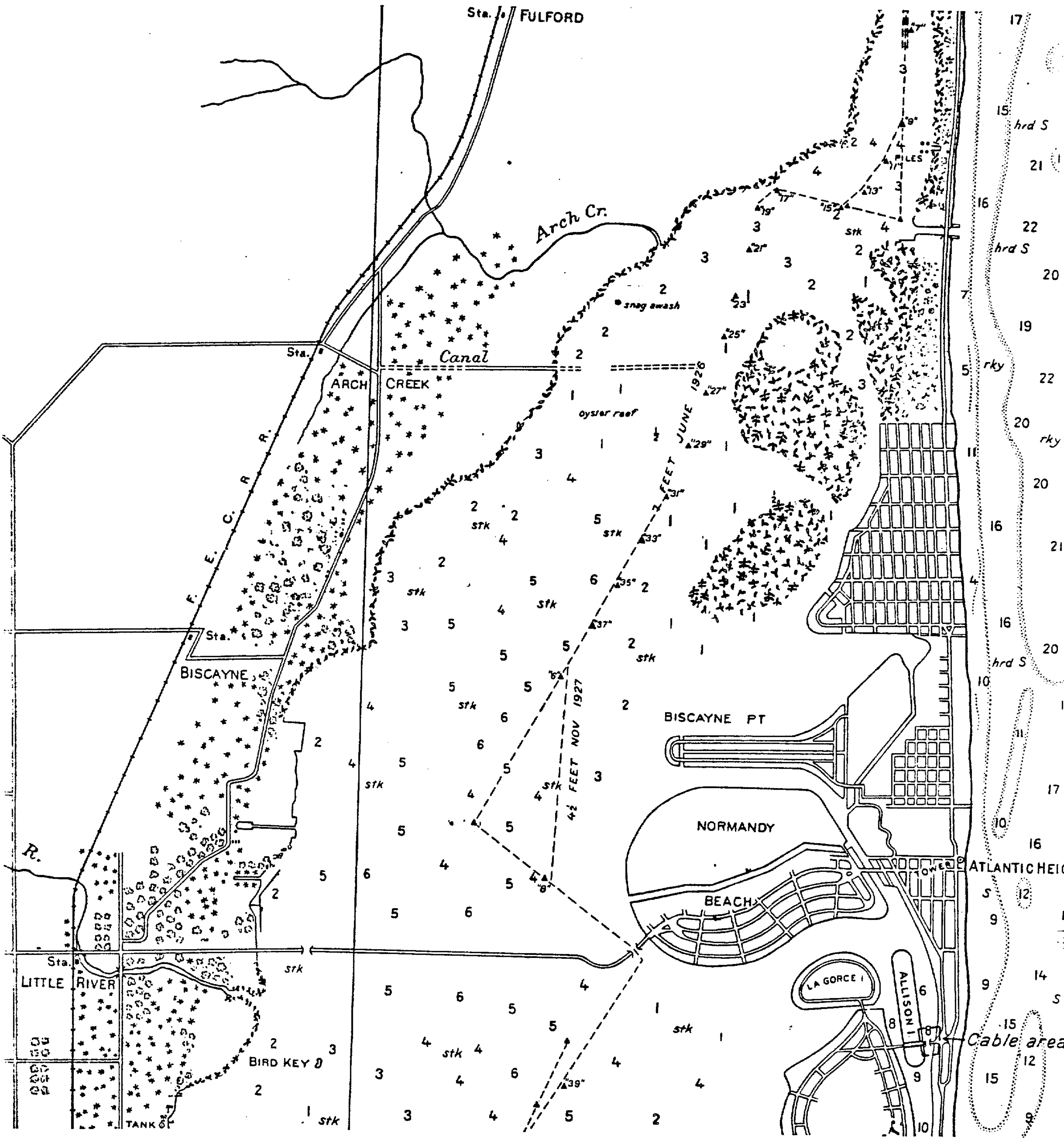


FIGURE 59

NAVIGATIONAL CHART OF BISCAYNE BAY AREA, 1928

SOURCE: U.S. COAST & GEODETIC SURVEY
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

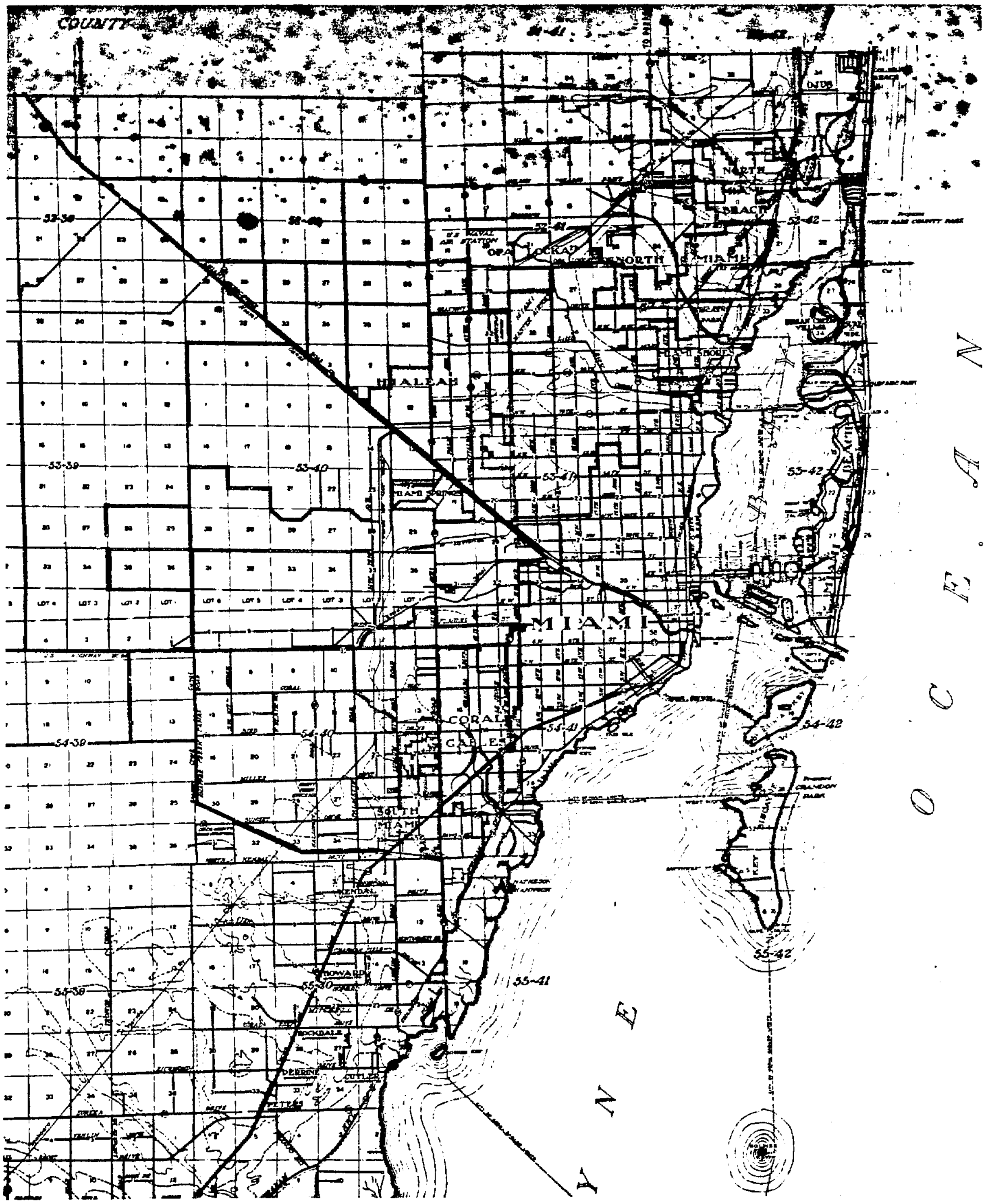


FIGURE 60
OFFICIAL MAP OF DADE COUNTY, FLORIDA, 1941
SOURCE: DADE COUNTY ENGINEER
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

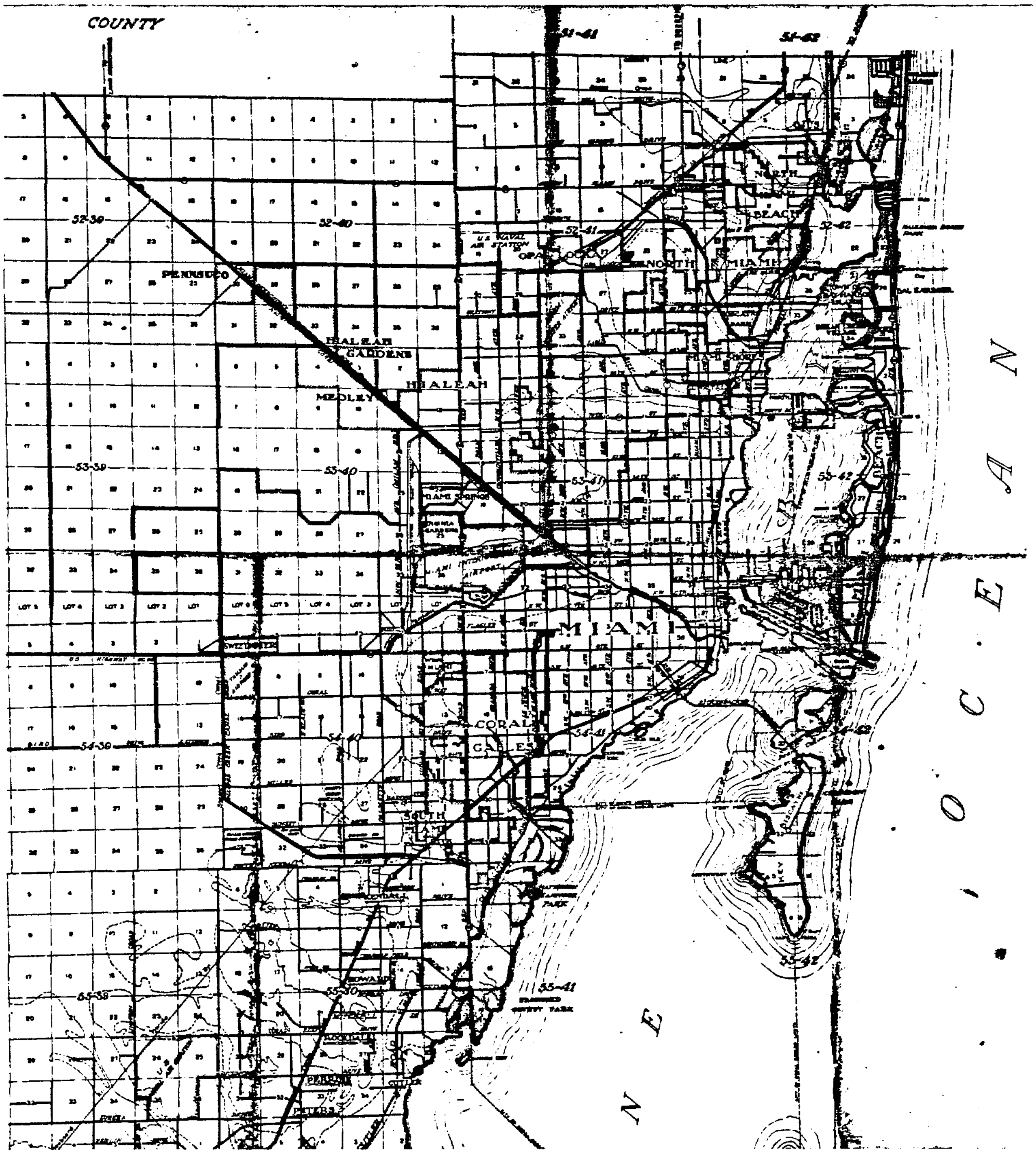


FIGURE 61

OFFICIAL MAP OF DADE COUNTY, FLORIDA, 1949

SOURCE: DADE COUNTY ENGINEER
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

of Quayside, a large condo development with a 63 slip marina at NE 106th Street, and construction of a 29 slip marina at Mariner's Bay.

At Pelican Harbor, Miss Florida, a restaurant built to look like a ship, was constructed on the west side of the island and the Florida Marine Patrol moved into new facilities and constructed a small dock. The most significant public project was the development of North Bayshore Park in the City of North Miami just south of the Broad Causeway.

Coastal Construction Activities. Between June 1980 and October of 1985, DERM issued about 70 coastal construction permits in Unit II. The estimated cost of the permitted work is almost one-half million dollars. Approximately one-third of the permits issued were for private seawall/bulkhead repair or replacement.

Unit II - 1986

In this area which has almost 25 linear miles of shoreline two facts stand out dramatically: less than one half of one percent of the shoreline is open to the public and relatively few boats are observed docked along the shoreline. More than ninety percent of the shoreline adjacent to this unit is devoted to residential uses, primarily single family homes adjacent to vertical bulkheads.

Public Access. North Bayshore Park in North Miami, Bayshore Park in Miami Shores and the Metro-Dade County facility at Pelican Harbor provide the only public access to the Preserve in this area (see Figure 40). The north shore of Pelican Harbor is presently underutilized. The Metro-Dade County Park and Recreation Department plans to upgrade this facility with an expanded marina, a sailing school and a launching area for small boats. The existing pelican/shorebird rescue facility, which is privately run, will be retained at the site, as will the Florida Marine Patrol operation. In contrast to the Pelican Harbor site which has the potential to be a heavily used active marine park, Miami Shores linear park is primarily a passive park. Miami Shores recently upgraded the shoreline of this park with new bulkheading and riprap.

The North Miami facility south of NE 123rd Street is a model of public, private and intergovernmental cooperation. Completed in 1984, this four acre mini-park, gives residents access to the Bay through a wooden boardwalk that doubles as a nature trail and fishing facility. In-water and shoreline improvements included removal of shoreline debris, riprapping, and construction of an artificial reef. The in-water work was financed by the Biscayne Bay Restoration and Enhancement Program. Landscaping, a picnic gazebo and parking were provided by the City of North Miami. The lighting was provided by Florida Power and Light Company.

In-Water Activities. Figure 62 generally illustrates the in-water activities which take place in this unit. The Intracoastal Waterway (ICW), which runs from northeast (at Broad Causeway) to southwest (at 79th Street Causeway), provides deep and direct boating access through the unit to other basins in North Bay. The Meloy Channel, actually an interconnected series of borrow pits that parallel the filled Miami Beach shoreline, is navigable from the ICW just offshore Indian Creek Island to the southwest corner of Unit II at the 79th Street Causeway.

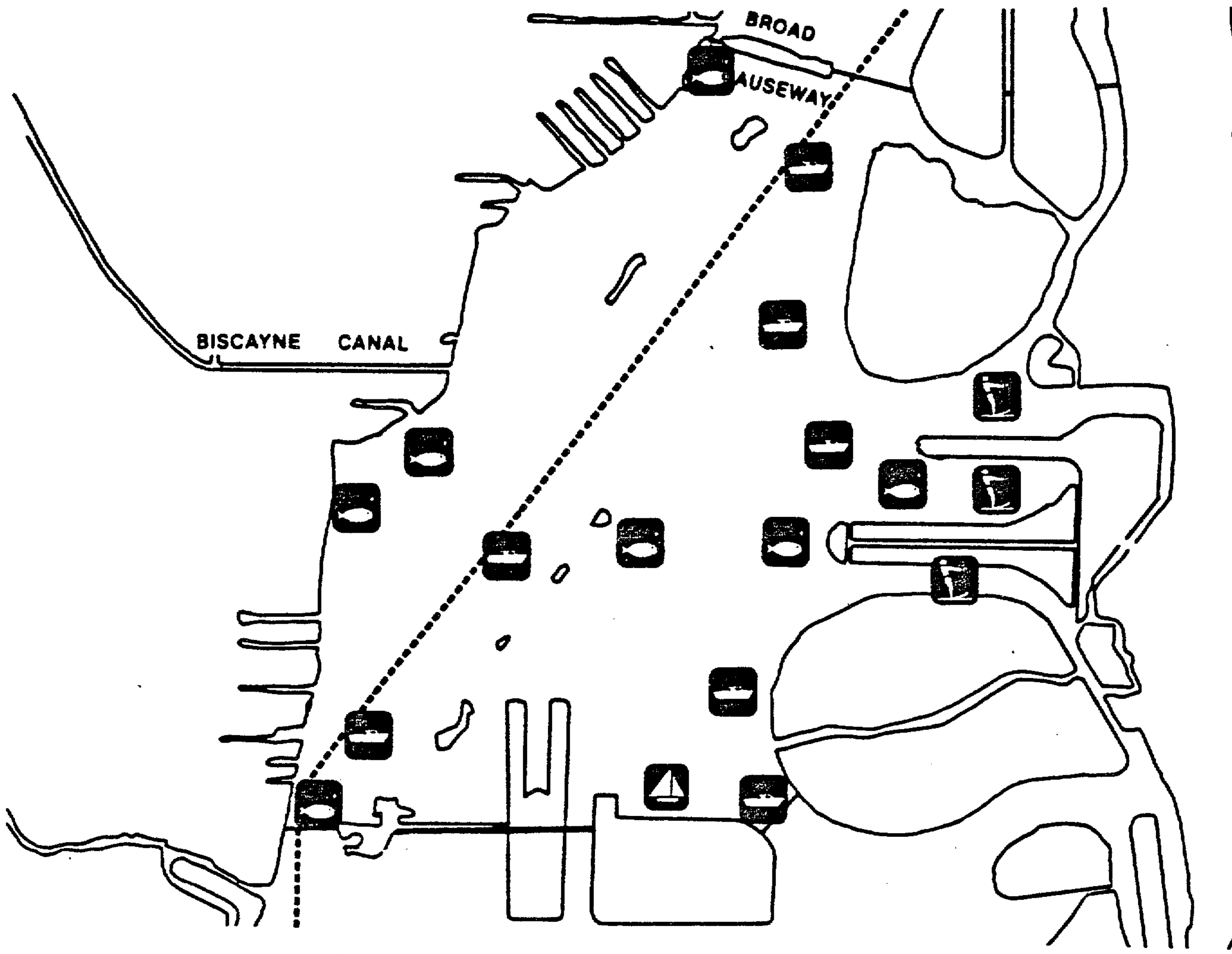


FIGURE 62

IN-WATER ACTIVITIES

SOURCE: METRO-DADE PLANNING DEPT., 1986

Waterskiing takes place along the lee side of Miami Beach in the vicinity of Indian Creek Island, Stillwater and Biscayne Points and north of Normandy Isle. Sailing takes place along the northern edge of Treasure Isle out of a sail boat rental facility on that island.

Fishing from boats generally takes place wherever there are shallows or flats in Unit II. Just offshore Biscayne and Stillwater Points and offshore of NE 98 Street are three such areas. Fishing from the shoreline takes place from a number of locations along Unit II, including: North Bayshore Park just south of the Broad Causeway at NE 123 Street; Miami Shores Bayshore Park at 95 Street; and from the 79th Street Causeway bridge.

There are only seven marinas within or adjacent to Unit II (Figure 63 and Table 16). All but one are either associated with condominiums or are private. Observation of aerial photos revealed that of the 200+ marina wet slips in Unit II, 56 percent were occupied in February of 1986.

TABLE 16

Marinas with more than 10 Slips in Unit II

No.	Type	Name/Address	No. of Wet Slips
12	Condo	Mariner's Bay Condominium 12000 N Bayshore Dr. North Miami	29
13	Private	Indian Creek Country Club	12
14	Condo/Club	The Jockey Club Marina Inc. 11111 Biscayne Blvd. Miami, FL	39
16	Condo	Towers of Quayside 10670 NE Quay Plaza Miami, FL	63
17	Public	Pelican Harbor Marina 79th St. Causeway Miami, FL	25
18	Condo	Harbour West Yacht Club 7910 West Dr. North Bay Village	26
19	Private	Racquet Club and Marina 7930 East Dr. North Bay Village	14
Total			208

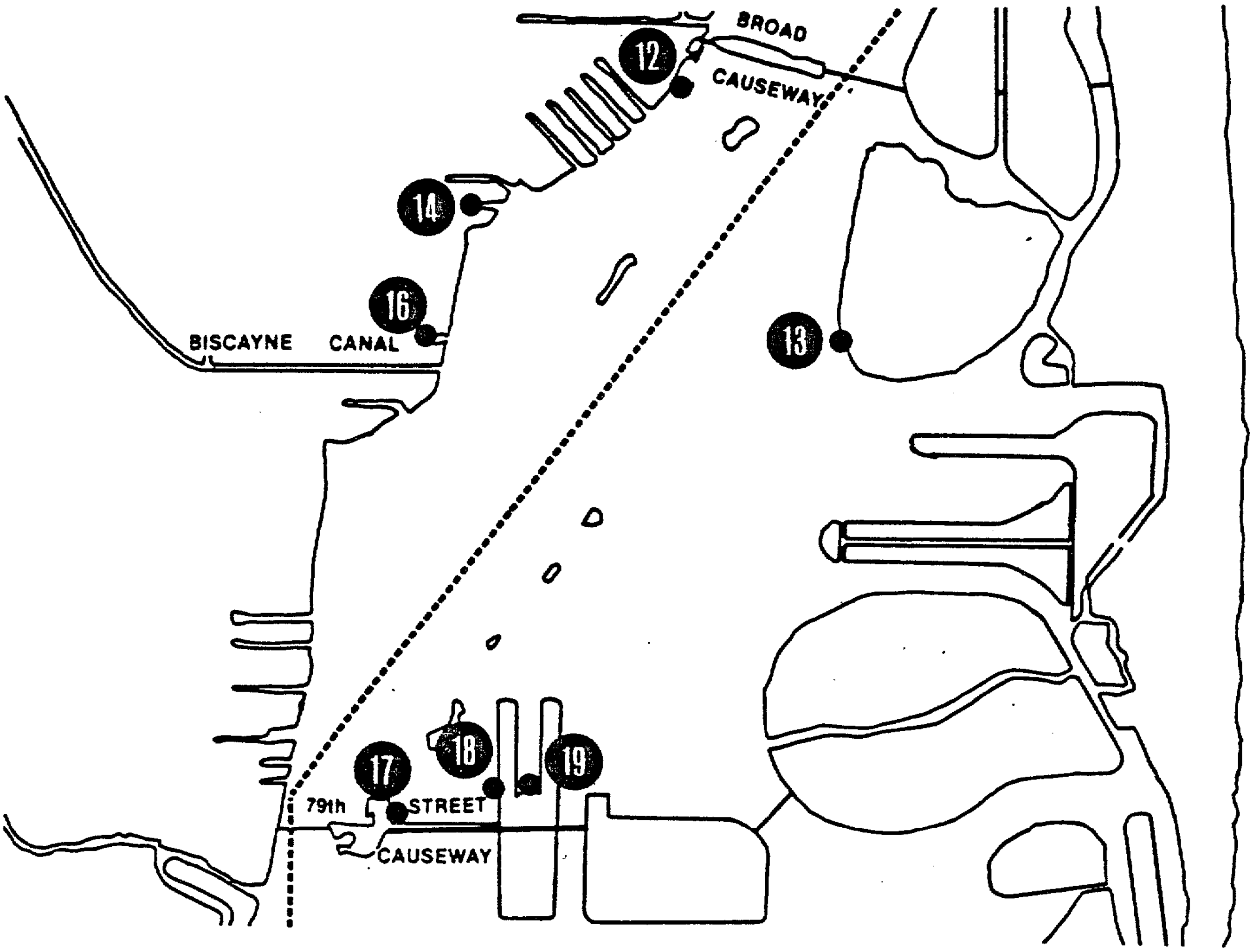


FIGURE 63

MARINA LOCATIONS

SOURCE: METRO-DADE PLANNING DEPT., 1986

Observation of aerial photos taken in 1985 showed a very low rate of dockage along the twenty plus miles of bulkheaded shoreline adjacent to single family homes within and directly adjacent to the APMA. Aerial counts in February of 1985 showed that there were only 41 boats docked along the mile-long navigable waterway below the salinity dam along the Biscayne Canal which is outside the APMA. Across the Bay, on the south side of the Broad Causeway along the Bay Harbor Islands, there were 73 docks with only 19 boats docked; along Indian Creek Village there were 34 docks but only one boat in the water; on Stillwater Point there were about 100 docks with 17 boats docked; along Biscayne Point there were 93 docks with 8 boats docked; and only 11 boats were docked in the Tatum Waterway and behind Parkview Island.

The above figures are indicative of the underutilization of Unit II for boat dockage. A number of factors contribute to this situation. Large boats and sailboats must travel through four bridges in order to reach the Ocean or south Bay. Many of the smaller boats which could pass through the Haulover Bridge are not able to safely negotiate the difficult currents within the inlet. Most of this area, except for Biscayne Canal, does not provide safe hurricane shelter for boats. Therefore, most boat usage in Unit II is either north/south bound ICW through traffic, small ski/fishing boats, or sailboats.

Submerged Lands. Limited available data on submerged land conveyances in this area indicate that at least nine submerged parcels have been transferred from State ownership or given spoil or canal easements. These include land Bayward of Stillwater Point, land adjacent to Biscayne Point, parcels adjacent to North Bay Village and Pelican Harbor Park and the submerged lands in North Bayshore Park (figure 64).

Within Unit II the City of North Miami's jurisdiction extends out into the Bay southeast of San Souci, Miami Shores' jurisdiction extends across the Bay to within a few hundred yards of the tip of Biscayne Point, and the cities of Miami and Miami Beach and North Bay Village also have jurisdiction over broad areas of the Bay bottom. Surfside has a small area of Bay bottom land under its jurisdiction. Indian Creek Village has jurisdiction over shoreline construction, but its jurisdictional boundaries do not extend out into the Bay (Figure 65).

There are several submerged wrecks, cable crossing and pilings in this area. Submerged wrecks are shown on navigational charts west of the ICW in the San Souci area, about a half mile offshore of the Jockey Club, east of the ICW due west from Stillwater Point and east of Harbor Island. There are major cable crossings south of Broad Causeway and through Indian Creek Island, from the tip of Normandy Isle to the eastern tip of Harbor Island and adjacent to the 79th Street Causeway (see Figure 43).

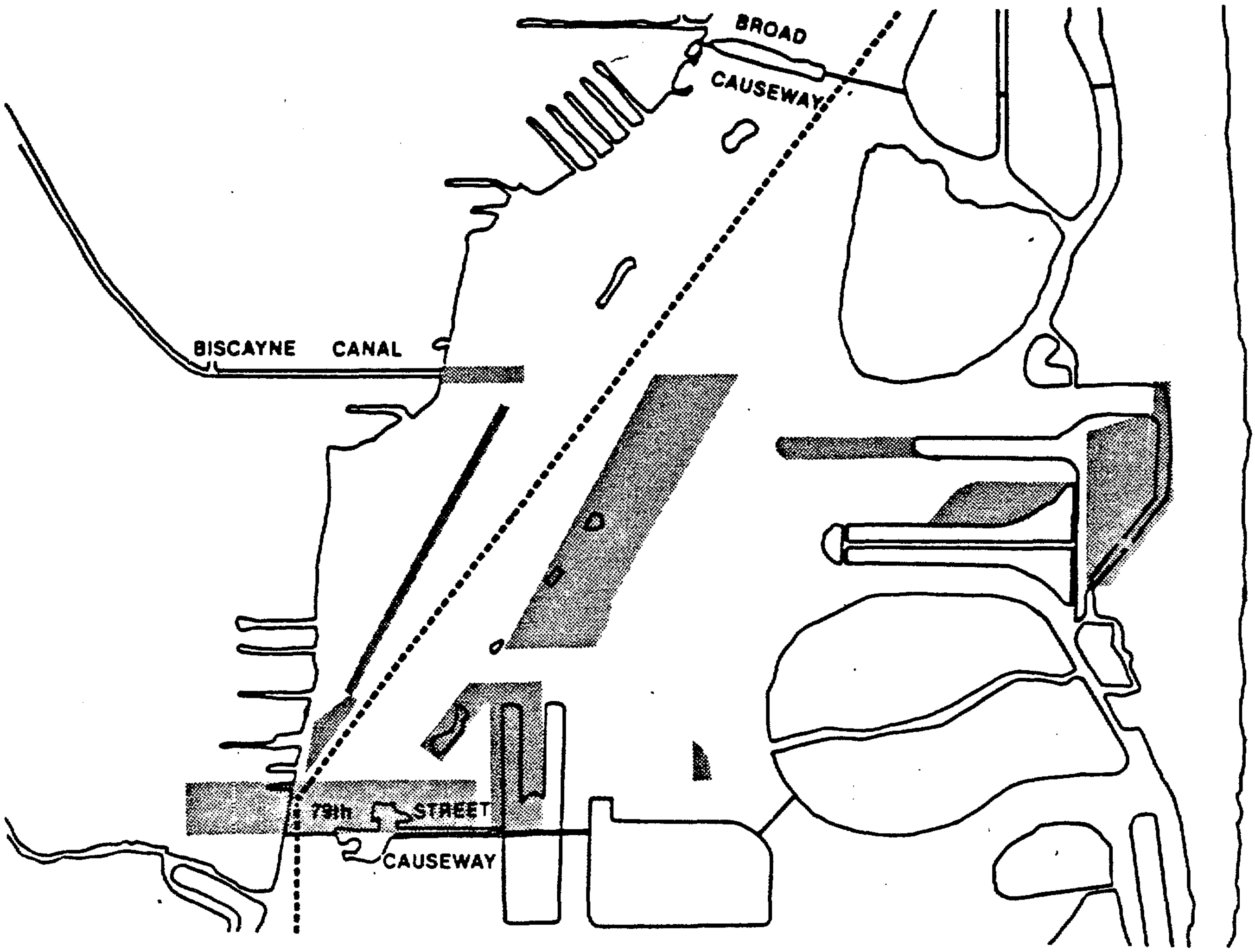


FIGURE 64

SUBMERGED LAND CONVEYANCES

LANDS CONVEYED TO FEDERAL, COUNTY, MUNICIPAL OR PRIVATE OWNERSHIP

SOURCE: FLORIDA DEPARTMENT OF NATURAL RESOURCES

NOTE: THIS INFORMATION HAS NOT BEEN REVERIFIED DURING THIS PLANNING PROJECT BY FDNR

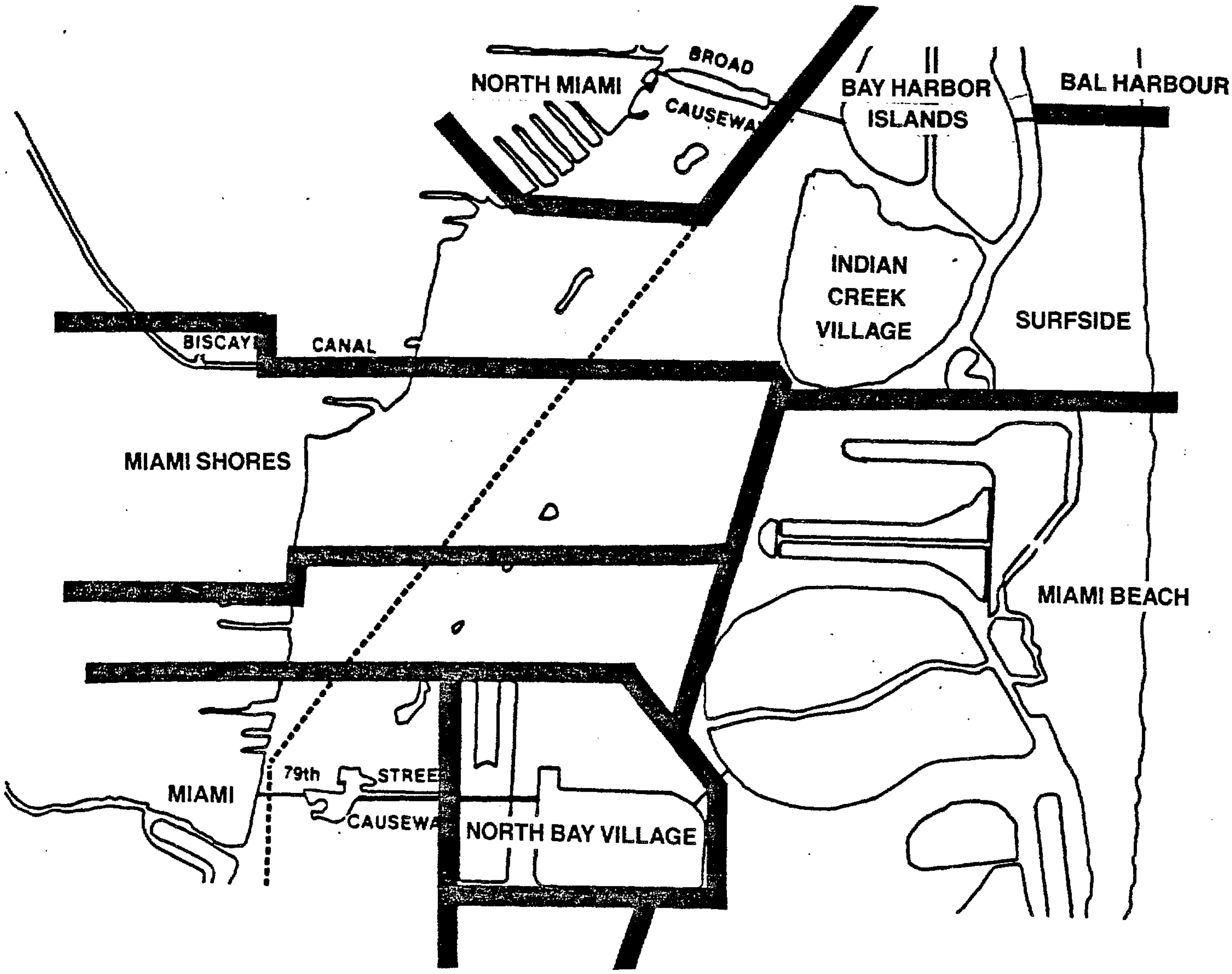


FIGURE 65

MUNICIPAL JURISDICTIONS

SOURCE: METRO-DADE PUBLIC WORKS DEPARTMENT, 1983

UNIT II

MANAGEMENT OPPORTUNITIES

Figure 66 shows the locations for management opportunities within Unit II. They are grouped under the general headings which coincide with the general management recommendations in Chapter 1. The numbers listed below correspond to the numbers on Figure 66.

Water Quality

1. Stormwater Outfalls. Based on size alone the large outfall on the western side of Harbor Island and the ten outfalls greater than 30 inches in diameter (see Figure 58) should receive priority for redesign and retrofitting.

2. Permitted Activities. Because of the poor circulation, poor water clarity and long residence times, no further activities that would degrade water quality should be permitted within or adjacent to this Unit.

3. Trash and Litter. Trash and floating debris accumulates along the shoreline corner off NE 100th Street in Miami Shores. This area should receive frequent trash pick up during the months when prevailing winds from the southeast keep the trash trapped along this part of the Bay shoreline.

Resource Conservation

4. Broad Causeway. The Town of Bay Harbor Islands should be encouraged to riprap the southern edge of the Broad Causeway and to plant mangroves, if feasible.

5. Mangrove Plantings. Additional mangrove plantings should be made along the 79th Street Causeway in conjunction with the expansion of Pelican Harbor Marina, or in conjunction with redevelopment on the north side of Treasure Island in North Bay Village.

Public Access

6. Shoreline Walkway. To the east of Parkview Island on Miami Beach, there is a public open space and designated park area which is presently used for a water tower. North of Biscayne Elementary School, there are several hundred feet of shoreline on Tatum Waterway. Together, these parcels include over 2200 feet of shoreline which could be the location of a public shoreline walkway. A walkway at this location could also be linked via the existing Northshore Park to the ocean beach south of 73rd Street.

7. Treasure Island - 79th Street Causeway. There are several under-utilized parcels and older buildings on the north side of Treasure Island which will undoubtedly undergo redevelopment within the short (5-10 year) term. Transient dockage and shoreline walkways should be encouraged at this location to improve visual and physical access to the Bay.

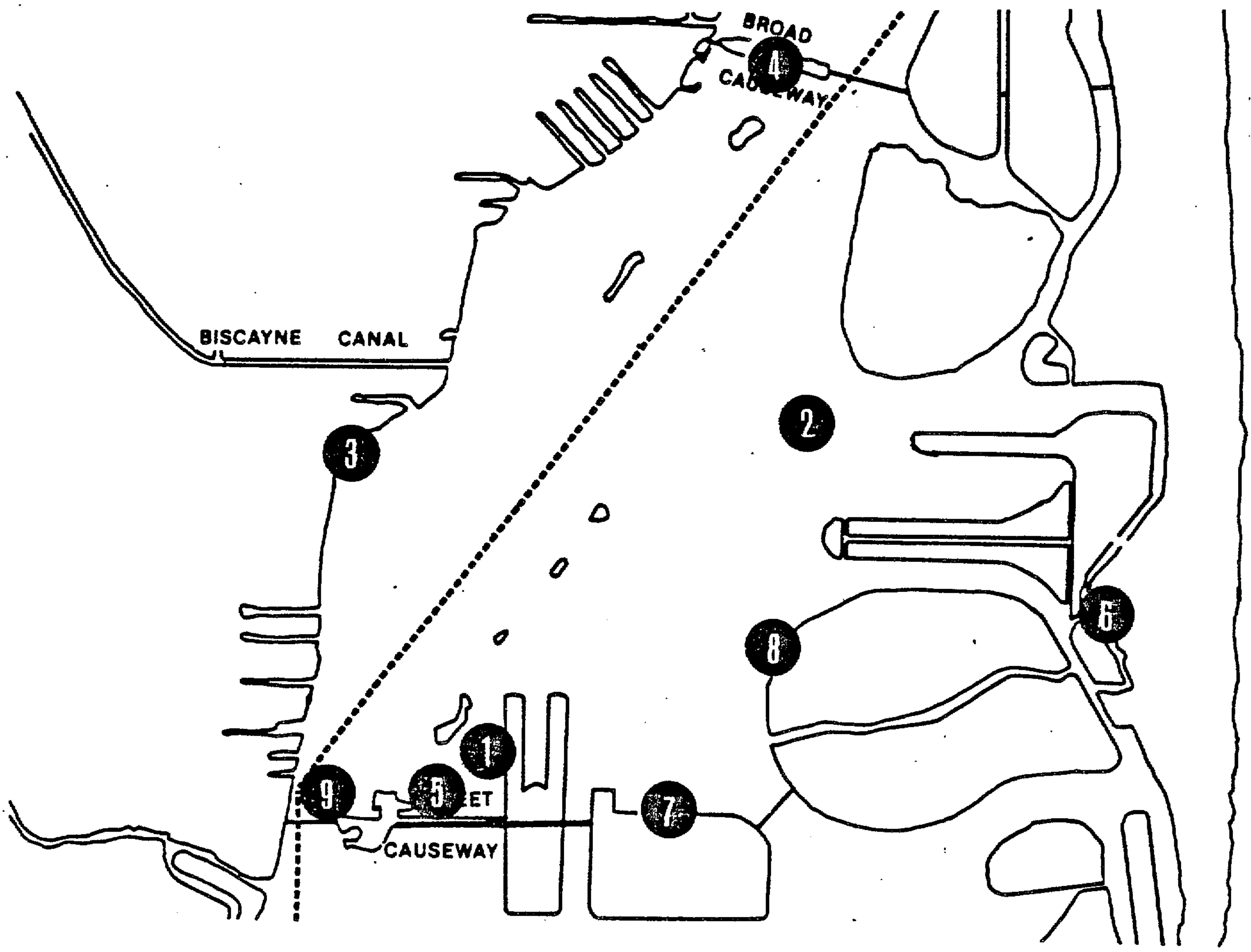


FIGURE 66
MANAGEMENT OPPORTUNITIES UNIT II

8. Normandy Island. There is a trash transfer station at the western end of the Normandy Island Golf Course on a parcel that is municipally owned and designated as "park". The trash transfer station should be moved to a more appropriate location. This area should be landscaped to provide views of the water and benches should be provided so that people can sit and enjoy the Bay.

Public Safety

9. Idle Speed/No Wake Zone. The Florida DNR Marine Patrol should investigate the feasibility of establishing an idle speed/no wake zone in the vicinity of the ICW channel under the 79th Street bridge.

ID#1345/ee

CHAPTER 4

UNIT III

79th Street Causeway to the Julia Tuttle Causeway

Introduction

Unit III is bordered by the 79th Street Causeway and North Bay Village on the north, Miami Beach east of Indian Creek on the east, the Julia Tuttle Causeway on the south, and the mainland in the City of Miami from NE 36th Street to NE 79th Streets on the west. The APMA includes Little River to the salinity dam north of 82nd Street and Indian Creek, but it does not include the Biscayne Waterway or Surfside on the Miami Beach side or Sable Lake west of Bay Point in the City of Miami (Figure 67).

The open water area of Unit III consists of 8.0 square miles. Ninety percent of the 23.3 linear miles of shoreline is bulkheaded (see Figure 18). This unit has a higher percentage of bulkheading than any other basin in north Bay. There are an additional 2.5 linear miles of spoil island shoreline. Bird Key, a natural mangrove island that was used as a spoil site during the dredging of the ICW, is still ringed with mangroves.

Water depths vary from 29 feet in dredged holes north of the Julia Tuttle Causeway to less than one foot and shoal at mean low water. The average depth of Unit III is 3.7 feet (see Figure 14). There are over 5 miles of submerged cuts and more than seven miles of exposed edges of seagrass beds.

Some of the lowest turbidity levels in northern Biscayne Bay are observed on the broad, shallow seagrass covered bank which covers most of the center of Unit III. As discussed in Chapter 1, this grass/algal bed is the most biologically rich and unique area within the entire Aquatic Preserve Management Area, and rivals any of the communities sampled within Biscayne National Park in central and south Biscayne Bay in terms of biological diversity and productivity. However, at the margins of Unit III erosion of submerged cuts and reflection of waves and boat wakes from seawalls cause the water to be turbid (Wanless, 1984).

As discussed in Chapter 1, net water flows through this area in a southerly direction. Water enters this unit from the openings in the 79th Street Causeway to the north and the openings in the Julia Tuttle Causeway to the south. Freshwater is discharged into Unit III from the Little River Canal. As noted in Chapter 1, the inputs from the Little River Canal are also largely responsible for degraded water quality conditions that are observed in the western portion of this area. Two extremely large storm water outfalls discharge into the Little River just downstream of the salinity structure S-27 north of 79th Street. In addition there are very large outfalls near Morningside Park and on the mainland side of the Julia Tuttle Causeway. These systems drain many miles of highly urbanized roadways including 36th Street. More than 150 outfalls over 12 inches in diameter discharge storm water runoff directly into this unit or into waterways that connect to this unit (Figure 68).

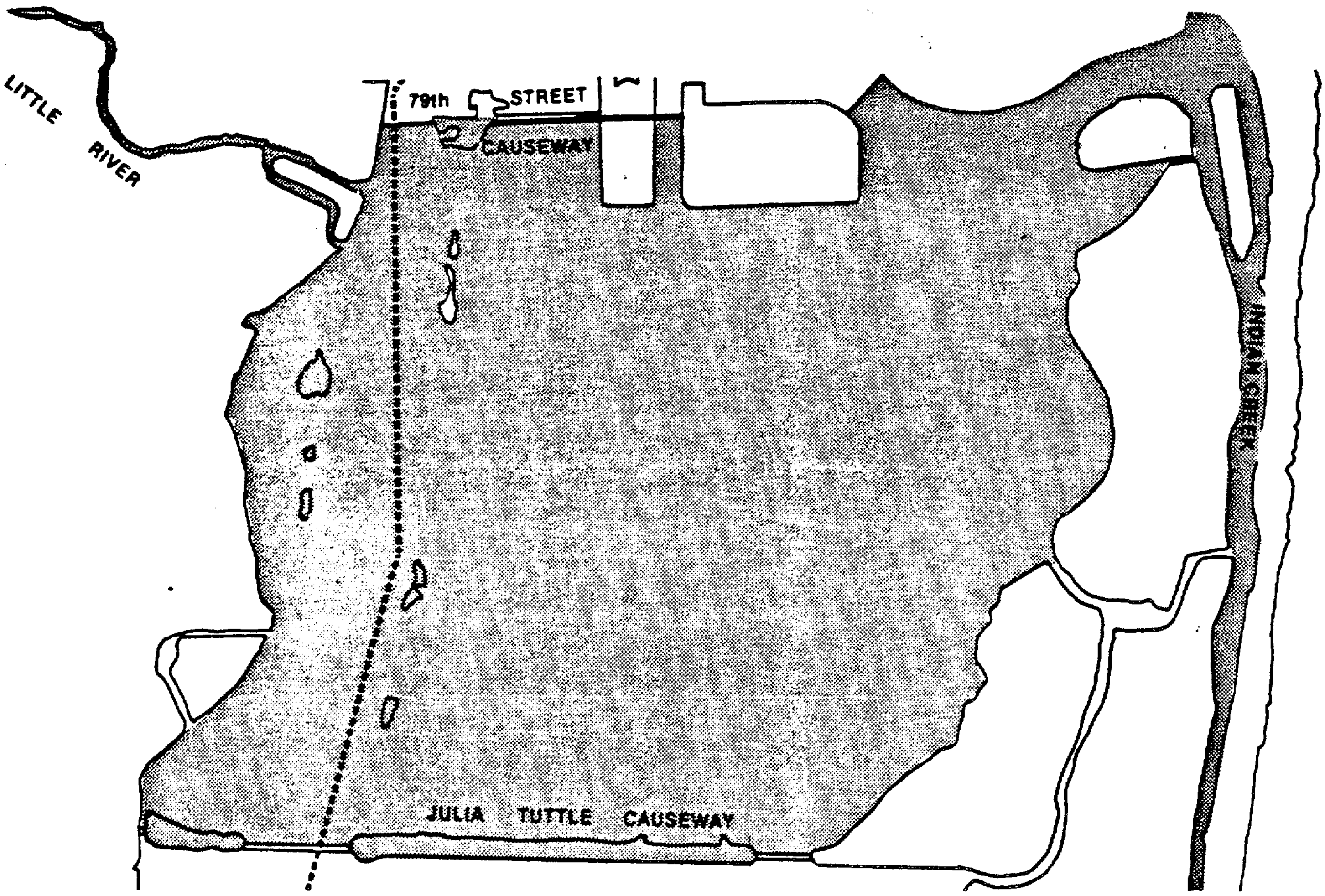


FIGURE 67
UNIT III

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

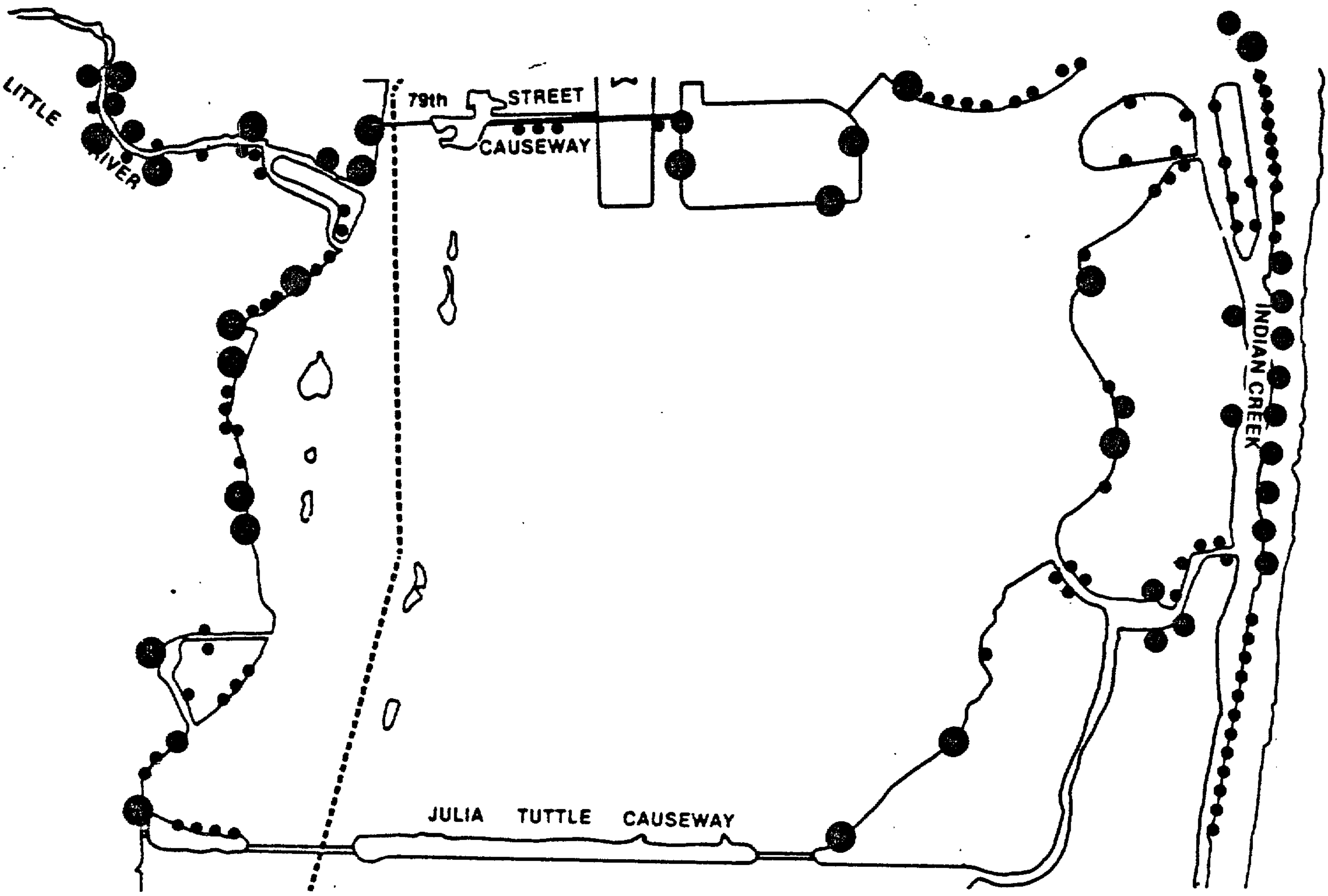


FIGURE 68

STORM WATER OUTFALLS

- ≥ 30″
- 24-30″
- 12-23″

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

Historical Background

The area between the present 79th Street and Julia Tuttle Causeways has undergone dramatic changes during the past two hundred years. A 1770 map drawn by DeBrahm shows an inlet that connected Indian Creek to the Ocean at the approximate location of present 48th Street. This inlet was called Boca Ratones by the Spaniards, however the term did not refer to rats, but rather to sharp submerged rocks which were found on the Atlantic side of the inlet. Deposition of sedimentary materials caused this inlet to naturally close by 1822.

In 1887, the entire shoreline in this area was lined with mangroves (Harlem, 1979). By 1925 there were only .2 square miles of mangroves remaining (see Figure 49) mostly on the southern portion of Normandy Isle (Harlem, 1979).

According to Harlem (1979) a broad shoal stretched across this area from northwest to southeast. Prior to 1925 this expansive shoal was between 3 and 6 feet deep and contained only sparse and patchy benthic cover. With the opening of Baker's Haulover in 1925, seagrasses quickly colonized this shoal. Dredging on the eastern side created a channel pattern that apparently caused scouring on the eastern portion of the bank during the hurricane of 1929. Since most of the dredging activities in this unit took place close to the shorelines, most of this cross-bay shoal still exists and is now abundantly vegetated (see Figure 33).

Dredge and fill activities from the 1920's through the 1960's changed the shoreline configuration and the open water area of Unit III. On Karl Squires map dated 1924, La Gorce and Allison Islands are shown as regularly shaped, possibly bulkheaded and filled (Figure 69). On the US Coast and geodetic survey map dated 1928, these islands are shown with roadways (see Figure 59). On this 1928 map the shoreline north and south of Little River, including the future Belle Meade Island and Bay Point areas, are shown as unbulkheaded and bordered by a thin band of mangroves along the shoreline.

In July 1928, the two lane 79th Street Causeway opened to traffic, and this in turn, opened Units II and III to further development. A US Coast and Geodetic Survey map (#583) dated 1931 shows Belle Meade in its present boot-shaped bulkheaded configuration in the mouth of the Little River. While Belle Meade is shown without roads, this map indicates roadways on the southern Normandy Isle. North Bay Island (south of Harbor Island and 79 St. Causeway) was dredged in the late 1930's and appears in its present shape on the official Dade County map dated 1941 (See figure 60). Johns and Collins Islands located just offshore of Miami Beach (where Mount Sinai Hospital is now located) were shown on this 1941 and Dolphs's 1952 map. The Julia Tuttle Causeway, the southern boundary of Unit III, was opened to traffic in 1962.

In summary, since 1925 the expansion of Normandy Isle, Allison Isle and the Mt. Sinai Hospital grounds and the creation of the 79th Street Causeway, the North Bay Village Islands and the Julia Tuttle Causeway accounted for a 12 percent decrease in the open water area (Harlem,

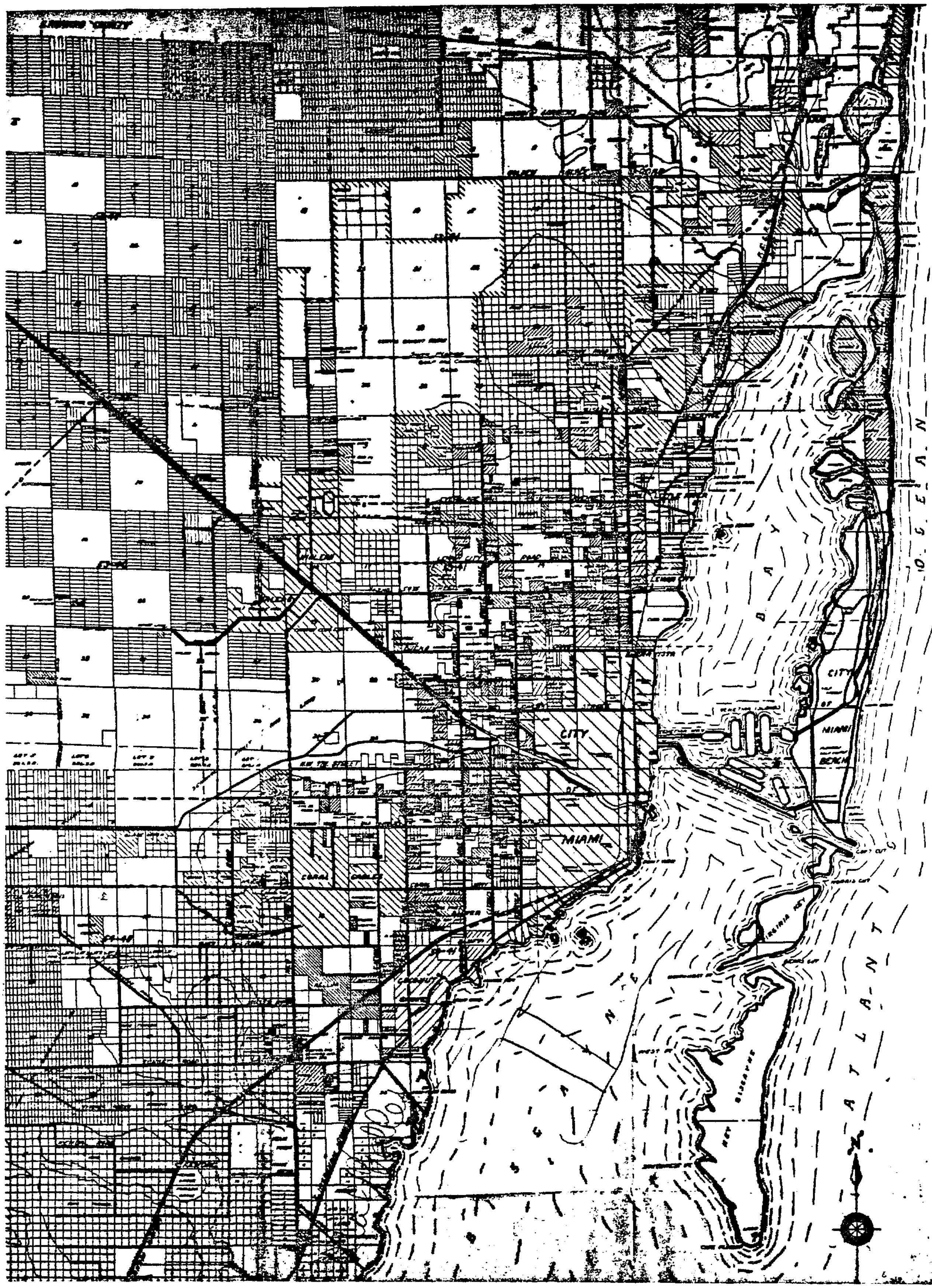


FIGURE 69

LOCATION MAP OF A PORTION OF DADE COUNTY 1924

SOURCE: Karl Squires, Mapmaker

HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

1979). However, the length of the shoreline nearly doubled. Except for the few mangroves that have established themselves on the flats just north of the Julia Tuttle Causeway, the mangrove shoreline that bordered this area in 1887 is entirely gone.

Changes Since 1974

The last of the major dredging and filling which shaped this area was completed with the digging of the huge borrow pit parallel to Julia Tuttle Causeway and the filling of the two mile long causeway island during 1959-62. However, since 1974 several changes have taken place in shoreline uses that have generally served to make this area more accessible to the public. A boat ramp was built at Legion Park. At Morningside Park the small ramp was doubled in size and a small fishing pier was constructed.

At Pelican Harbor Park on the south side of the 79th Street Causeway, the ramp area was improved, four finger piers were built, and the parking lot was expanded and paved. The first Bay Restoration and Enhancement Project, a fishing pier and offshore artificial reef, was completed in 1982 at this park.

In the deep borrow pit that was dredged to build the Julia Tuttle Causeway, an artificial reef has been created out of vessels, culvert pipes, beams and bridge sections and cleaned fuel tanks. This is now the largest artificial reef in Biscayne Bay.

On the Miami Beach side, Sailport has been constructed at a site on Indian Creek at 69th Street, which was formerly used as a municipal parking lot. Sailport will rent small sailboats and provide sailing lessons for children. Further south on Indian Creek at 63rd Street, a passive park with a small boat dock was developed.

During the 1960's and 70's, the shores of Indian Creek were lined with houseboats. Because of a 1983 Court Order, liveaboard vessels were required to either connect to the City's sewage disposal system (which was cost prohibitive), or have an approved marine sanitation device installed. The City of Miami Beach also designated the area along Indian Creek, from 41 to 55 Streets, as a marine district which allows pleasure craft dockage, but no liveaboards. Any houseboats that were docked there, were grandfathered in, but once they move, they cannot come back. These events have accounted for the significant decrease in the number of houseboats docked along Indian Creek from 1974 through 1986.

Coastal Construction Activities. Since June 1980, almost 40 coastal construction permits were approved for almost $260,000 worth of repair work and improvements in Unit III. Seawall repairs account for 12 percent of the cost of the work. About 20 more permit applications were pending in early 1986 for an estimated $210,000 worth of work in this Unit.

Unit III - 1986

Most of the shoreline adjacent to Unit III is devoted to single and multifamily uses. The western shoreline of this Unit from 79th Street to 36 Street is entirely residential except for Morningside, Legion, and Martell Parks, two street ends, and a few vacant parcels. Both Morningside and Legion Parks have boat ramps, and Morningside Park has a small fishing pier, all of which provide public access for residents of the surrounding area. A limited amount of additional access for shoreline fishing is also available at two street ends north of Morningside Park. All together the three City of Miami parks and two street ends provide about 3140 linear feet of shoreline public access to the Preserve along the western edge of Unit III. The City of Miami plans to purchase a parcel of land in the vicinity of NE 69th Street for use as a marina, which could further increase public access along the western side of this unit.

Julia Tuttle Causeway. The major opportunity for shoreline public access in Unit III remains the opening of the Julia Tuttle Causeway spoil area. The problems with realizing this potential for public shoreline access stem largely from opposition of shoreline residents on the mainland side and from difficulties in securing the necessary approvals from Federal and State transportation officials to provide limited egress and ingress from the Julia Tuttle Causeway, which is designated as an Interstate (I-95) spur. If these obstacles are overcome, the two mile expanse of the main causeway spoil island will provide an incredible resource for trailerable boat launching, shoreline fishing, picnicking, viewing, swimming and snorkeling. The proximity of this area to the large grass bed to the north and the large artificial reef which has been created along the northwestern edge of the main causeway island makes this a valuable and truly unique site.

The Martell Park and western spoil island of the Julia Tuttle Causeway also afford some potential for improving public access to the Preserve in Unit III. The area between the eastbound and westbound lanes of the causeway is heavily used for shoreline fishing and shrimping even though it is not easily accessible.

The eastern shore of the Bay from Julia Tuttle Causeway north to the 79th Street Causeway is also almost exclusively devoted to single family residences. The only exception is Mt. Sinai Hospital which stretches for about three quarters of a mile along the shoreline just north of the Tuttle Causeway.

79th Street Causeway The south side of Treasure and Harbor Islands in North Bay Village is also entirely residential. However, the portion of Pelican Island on the south side of the Causeway provides excellent access to the Preserve for trailerable boats and shoreline fishermen who are frequently observed fishing from the large riprap boulders that line the shore. The artificial reef which was placed offshore from this site has probably increased fishing use and access from this site.

Although Pelican Harbor presently provides the most diverse range of public access opportunities available in Unit III, this site has the potential to provide more, and different kinds of public access. There is space on the south side to create a launching beach for small trailer-able boats. This would also be a good location for a facility for rental of shallow draft boats for those who wish to explore the grassbed to the south in an environmentally acceptable manner.

Indian Creek. Like the rest of the shoreline in Unit III the western shore of Indian Creek is almost completely lined with residences, except for a passive City of Miami Beach park and one very large vacant parcel. However, the eastern shoreline of Indian Creek from 41st to 71st Streets presents a sharply contrasting picture of land use to the residential/park uses that are found almost exclusively elsewhere adjacent to this unit. From 41st Street north to about 55th Street, Collins Avenue runs directly adjacent to the Creek. In this area there are several finger piers and parallel docks lining the Creek, but as discussed above, much of the former houseboat usage has been eliminated. In this area, the potential exists to link some of the municipally owned parcels via a shoreline walkway.

From about 55th Street north to 63rd the eastern shore of Indian Creek is lined with condominiums, most of which also have finger piers or docks. Several of these buildings include tennis courts along the shoreline. From 63rd to 71st Street the land uses along the eastern shore of Indian Creek are quite variable. Just north of 63rd Street the municipally owned Indian Creek Park stretches for more than 1000 feet. As one proceeds north there are motels and parking lots, including a municipal lot at 65th Street, and residential/hotel uses. South of 69th Street there is a City of Miami Beach Fire Station and Sailport, the municipally owned facility that will be used to teach children how to sail. Future improvements planned for this site include sixty feet of floating dock, a maintenance facility and a pram storage area. To the north, 69th Street dead ends on Indian Creek and there is a large vacant parcel with about 300 feet of frontage of the Creek.

In-Water Uses. Many different in-water uses occur in this basin, which has the largest amount of open water of all the north Bay units (Figure 70). As in Unit II, waterskiing takes place along the lee side of Miami Beach. Windsurfing and sailing take place just south of the 79th Street Causeway and Pelican Harbor Park. Boats can be launched from ramps at Pelican as well as from Morningside (at NE 56 St.) and Legion (NE 65 St.) Parks. In addition to the public boat ramps, there are twenty private and commercial marinas in Unit III with more than ten slips (Table 17 and Figure 71).

The ICW on the western side and Meloy Channel parallel to the eastern shore provide deep, direct boating access through Unit III. The borrow pit just north of the Julia Tuttle Causeway and the deep area south of the 79th Street Causeway Islands provide east/west access between the ICW and Meloy Channels.

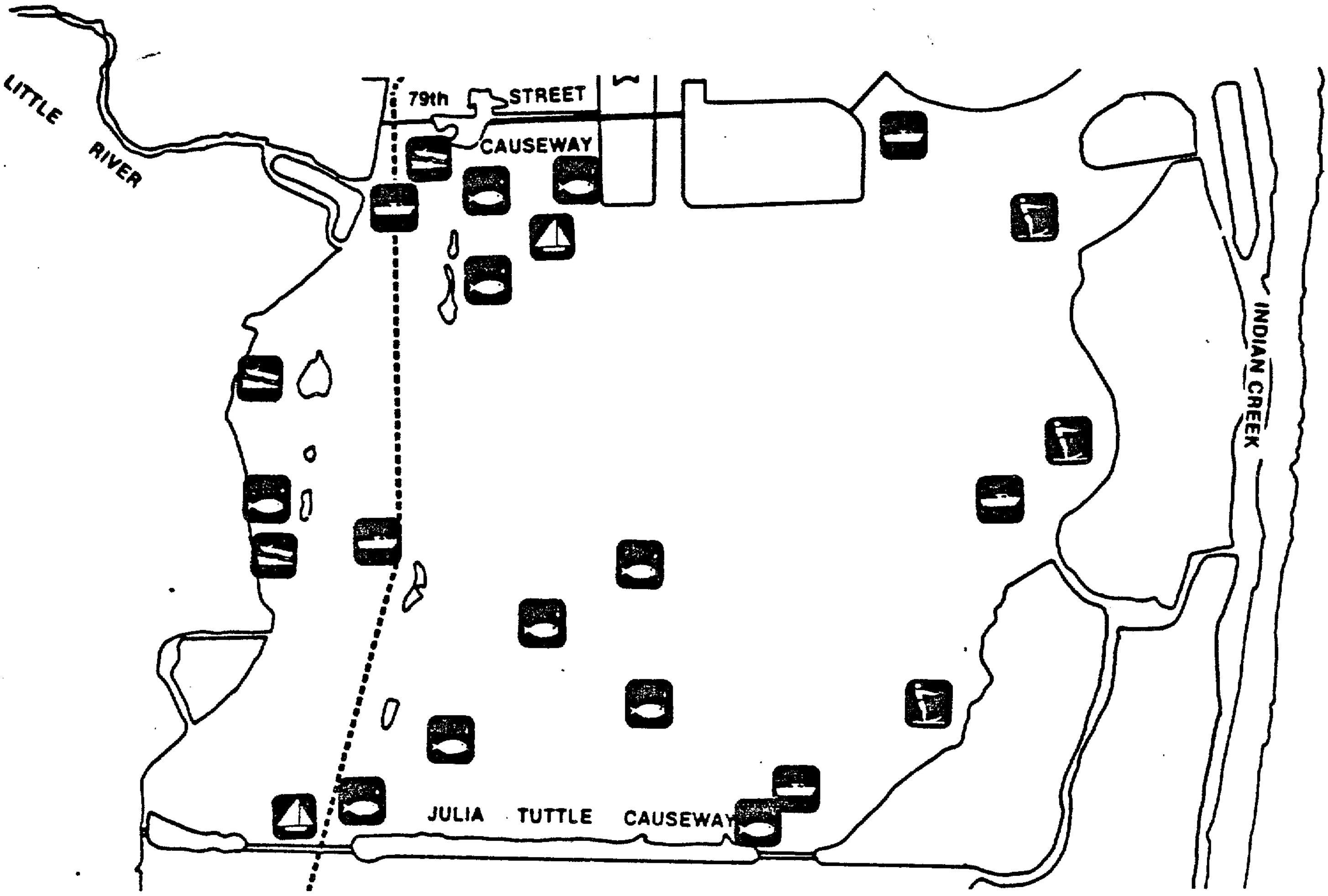


FIGURE 70

IN-WATER ACTIVITIES

SOURCE: METRO-DADE PLANNING DEPT., 1986

TABLE 17

Marinas With More than Ten Slips
in Unit III

No.	Type	Name/Address	No. Wet Slips	No Dry Slips
Biscayne Bay Area				
23	Condo	Palm Bay Club Marina and Club 720 NE 69th St.	77	12
24	Condo	Banyan Bay 703 NE 63 St.	30	
25	Commercial	Flamingo Yacht Basin & Marina 1900 79th St. Causeway	74	
Little River Area				
20	Condo	Marine Plaza Apts. 660 NE 78th St.	25	
21	Commercial	Little River Marina 724 NE 79th St.	20	275
22	Commercial	Skyway Marine 79th Street	12	25-30
Indian Creek Area				
26	Condo	King Cole 900 Bay Drive, Normandy Isle	30	
27	Condo	Approx. 6900 Indian Creek Dr.	10	
28	Condo	Approx. 6800 Indian Creek Dr.	18	
29	Condo	Manhattan Tower 6770 Indian Creek Drive	16	
30	Condo	5660 Collins Avenue	10	
31	Condo	Sea Coast Towers 5600 Collins Avenue	18	
32	Condo	Approx. 5600 Collins Avenue	16	
33	Condo	Carriage House 5401 Collins Avenue	22	
34	Apt.	Imperial House 5255 Collins Avenue	10	
35	Condo/Apt.	Seasons South 5005 Collins Avenue	17	
36	Condo/Apt.	Executive House 4925 Collins Avenue	10	
37	Hotel	4833 Collins Avenue	11	
38	Hotel	Fontainebleau 4441 Collins Avenue	12	
39	Condo	Pine Tree Drive Arthur Godfrey Road	18	
		Total	456	315

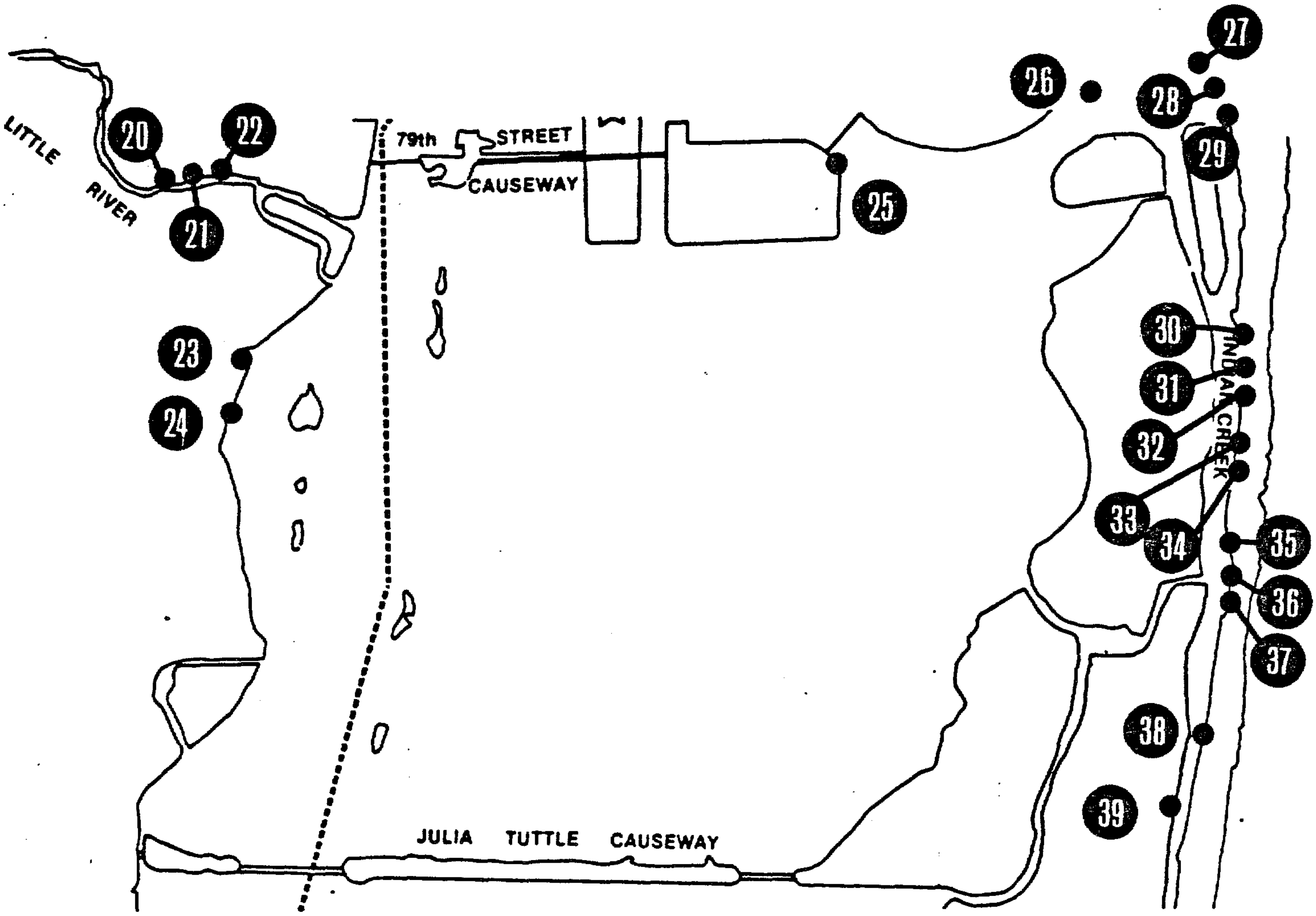


FIGURE 71

MARINA LOCATIONS

SOURCE: METRO-DADE PLANNING DEPT., 1986

Because of the rich productive seagrass bed in the middle of this area, Unit III is a good location for fishing. Fishing takes place from the shoreline in a number of sites along the Julia Tuttle Causeway; from the western end of the Causeway south of Martell Park; from Morningside Park and the streets in the immediate vicinity; from Legion Park; from the pier at Pelican Harbor Park; and along the 79th Street Causeway. The expansive shallow, seagrass-covered shoal area provides boating fishermen with some of the best in-shore opportunities in all of Biscayne Bay. Sea trout, snapper and pinfish are caught in abundance. The artificial reef, located in a deep dredge hole in the borrow pit north of the Julia Tuttle Causeway, also attracts boating fishermen to Unit III.

The Bird Key Area, just offshore and across the ICW from the Little River is extremely shallow, and provides some of the best bird watching in north Biscayne Bay. Its mangrove shore is usually teeming with pelicans, cormorants and herons.

<u>Submerged Land</u>. Limited available data indicate that except for spoil easements, most of the open water area in Unit III has been retained in State ownership. Exceptions are submerged lands around Pelican Harbor and the Julia Tuttle Causeway which are in County ownership, Bird Key and adjacent lands and a large area offshore from the Jockey Club which are in private ownership (Figure 72). With the exception of a triangular segment that runs south from North Bay Village to the center of the Julia Tuttle Causeway, all of Unit III is within municipal jurisdiction (Figure 73).

Two cable crossings, several submerged pilings and obstructions, wrecks and the fish haven north of the Julia Tuttle Causeway are shown on navigation charts as prominent submerged land uses in the unit (see Figures 43 and 44). There is a major pipeline/cable crossing south of North Bay Village from the Little River area to Indian Creek. A second major cable crossing runs from the mainland south of Bird Key to the entrance of Lake Surprise on Miami Beach.

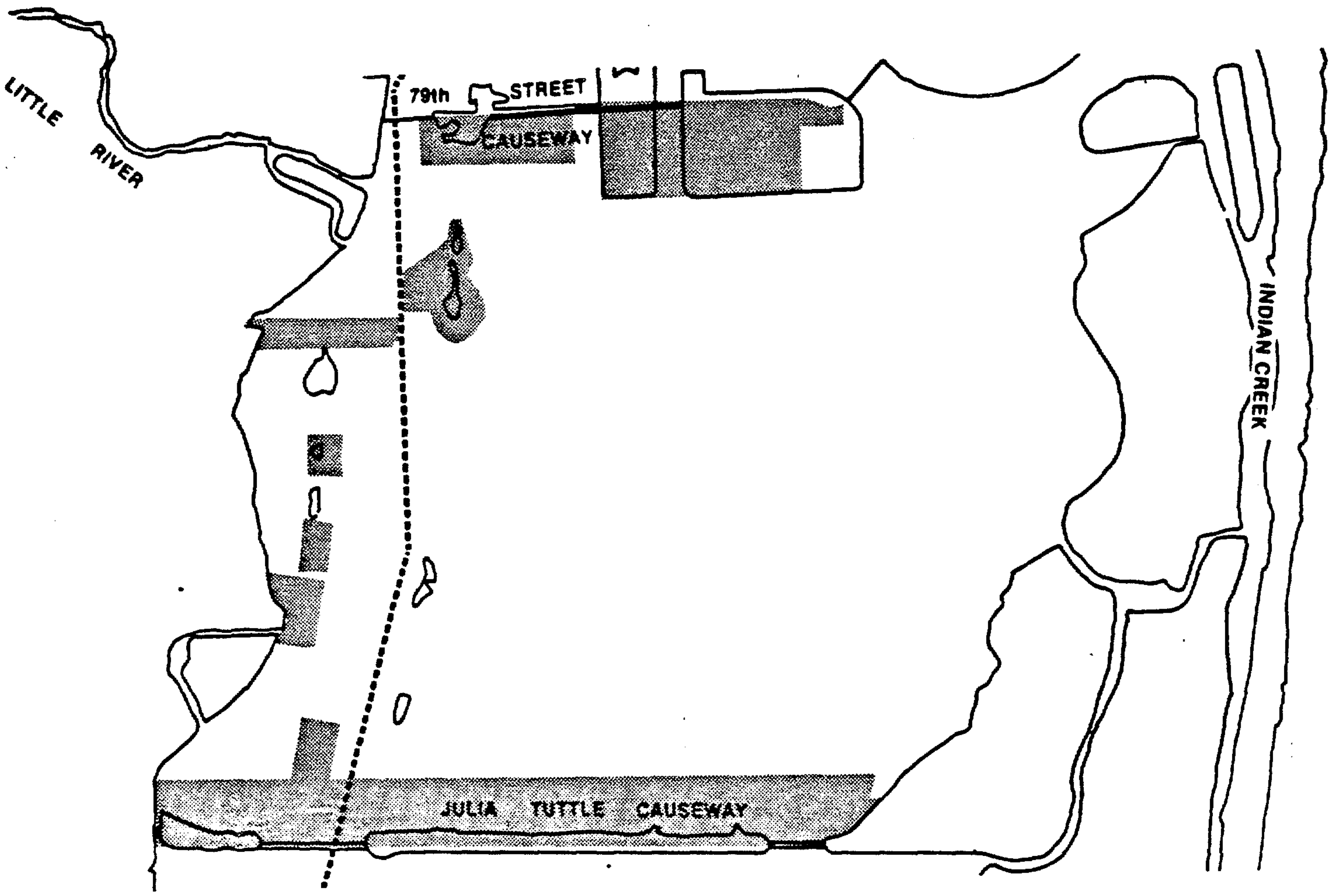


FIGURE 72

SUBMERGED LAND CONVEYANCES

LANDS CONVEYED TO FEDERAL, COUNTY, MUNICIPAL OR PRIVATE OWNERSHIP

SOURCE: FLORIDA DEPARTMENT OF NATURAL RESOURCES

NOTE: THIS INFORMATION HAS NOT BEEN REVERIFIED DURING THIS PLANNING PROJECT BY FDNR

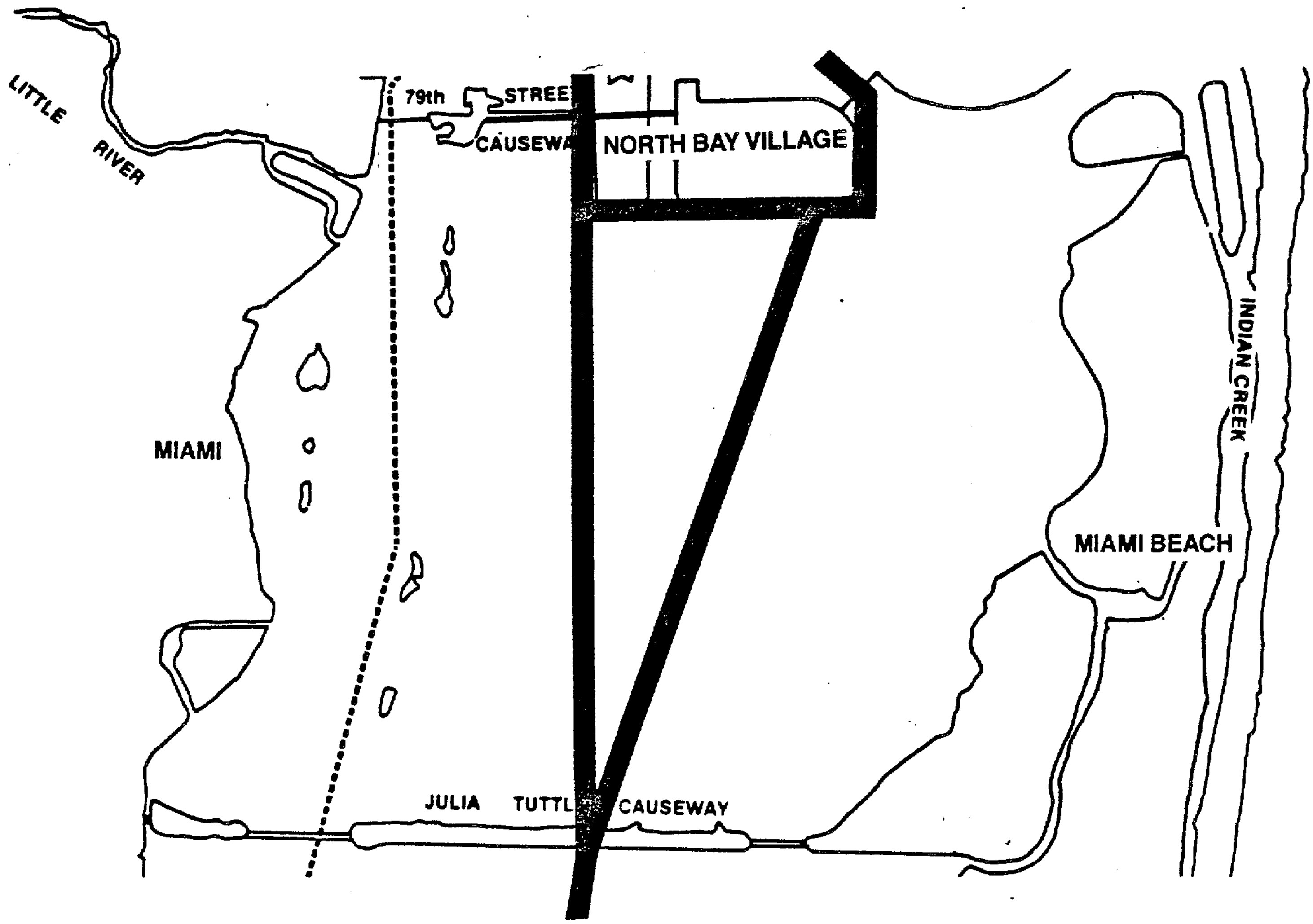


FIGURE 73

MUNICIPAL JURISDICTIONS

SOURCE: METRO-DADE PUBLIC WORKS DEPARTMENT, 1983

UNIT III

MANAGEMENT OPPORTUNITIES

There are several opportunities for implementing the general management recommendations given in Unit III. These are listed below and shown on Figure 74.

Water Quality

1. Little River. Because of the negative impact that the Little River had on the western side of this Unit, an intensive short term water pollution study should be undertaken to better understand the causes of pollution in the Little River.

2. Stormwater Outfalls. Very high priority should be placed upon redesigning or retrofitting the four large stormwater outfalls that discharge into the Little River and the 18 outfalls greater than 30 inches that discharge into the Bay (see Figure 68).

3. Indian Creek/Lake Surprise. An intensive clean up and enforcement campaign should be initiated for the Indian Creek/Lake Surprise area.

Conservation

4/5. (See general recommendations regarding purchase of Bird Key and protection of the large grass/algal flat in the middle of this Unit.)

Public Access

6. Julia Tuttle Causeway. The major opportunity for shoreline public access in Unit III remains the opening of the Julia Tuttle Causeway spoil area. The two mile expanse of the main causeway spoil island should be used to provide trailerable boat launching, shoreline fishing, picnicking, viewing, swimming and snorkeling.

7. Pelican Harbor - South Side. Although Pelican Harbor presently provides the most diverse range of public access opportunities available in Unit III, this site also has the potential to provide more, and different kinds of public access. North Bay Village is working with the Metro-Dade Park and Recreation Department to develop a local park facility on the west end of the County's property. This facility should provide recreation, picnicking and viewing areas for the use of North Bay Village residents, as well as for other residents from throughout Dade County. There is space on the south side to create a launching beach for small trailerable boats. This would also be a good location for small boat rental to provide access with appropriately shallow draft boats or canoes into the large grassbed area to the south.

8. Indian Creek. Along Indian Creek, the potential exists to link some of the municipally-owned parcels in the area south of 55th Street, via a shoreline walkway.

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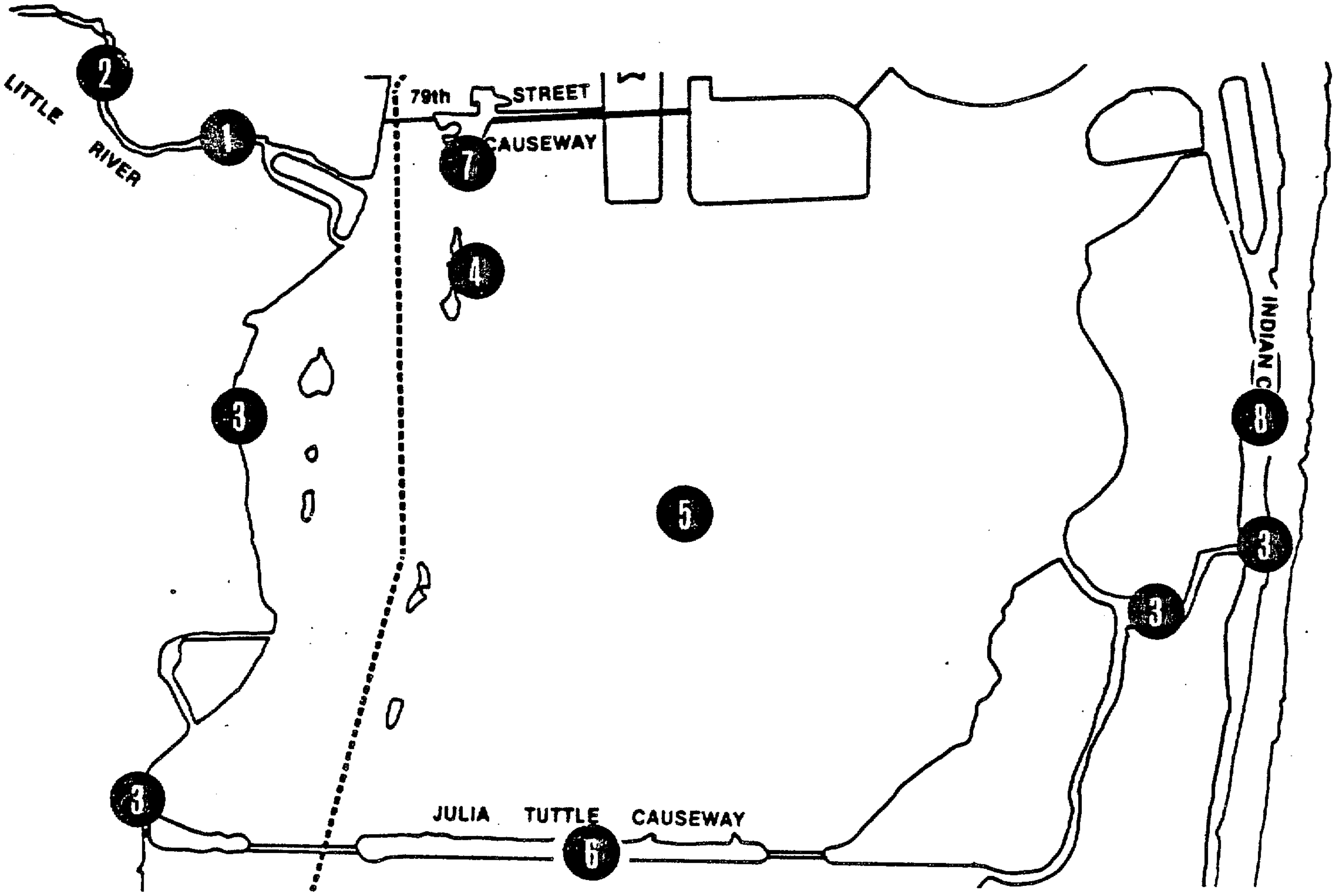

FIGURE 74

MANAGEMENT OPPORTUNITIES UNIT III

CHAPTER 5

UNIT IV

Julia Tuttle Causeway to the Venetian Causeway

Introduction

Unit IV is bordered on the north by the Julia Tuttle Causeway, on the east by Miami Beach east of Sunset Lake, on the south by the Venetian Causeway and on the west by the mainland shoreline from NE 13 to NE 36 Streets within the City of Miami. Indian Creek from Arthur Godfrey Boulevard south to and including Lake Pancoast is included within the boundary of the Aquatic Preserve, as is Sunset Lake to the west of the Sunset Islands, but Dade Boulevard Canal is not included within the APMA. On the mainland side, the inlet north of Pace Park and the smaller inlets at NE 28 and 33 Streets are also included within the APMA. All of the publicly owned uplands on islands within the area described are within the Aquatic Preserve (see Figure 75).

Today, this area includes less than three and one half square miles of open water bordered by six linear miles of vertical bulkheads and more than three miles of sloping, unconsolidated spoil shoreline (see Figure 19). Sixty four percent of the Bay bottom is barren and 35 percent is covered with seagrass and algae. However, most of the submerged vegetation is sparse and patchy, except for the seagrass bed located due south of the eastern end of the Julia Tuttle Causeway main island (see Figure 33). Bulkheads and rubble adjacent to seawalls may become encrusted with corals, soft corals and other reef dwelling organisms.

Construction of Julia Tuttle Causeway in the early 1960s brought about significant changes in much of the southern end of Unit III and northern Unit IV. The causeway cut through the rich shallow bank that dominates the midsection of Unit III, leaving only the southern end of the bank in Unit IV undisturbed.

The area just north of the Venetian Causeway has been dredged from nine to 15 feet, and there is a dredged trough adjacent to the mainland at NE 25 Street that has been dredged from ten to 17 feet (see Figure 15). In contrast, water depths in the undredged vegetated portions of this Unit range from two to five feet and the average depth of this Unit is 5.9 feet at mean low tide (van de Kreeke and Wang, 1984).

There are several sources of turbidity in this Unit. There are over three miles of unconsolidated shoreline including the Julia Tuttle Causeway and approximately seven miles of submerged cuts and flanks of borrow pits in this area. Turbidity is caused by wind and boat generated waves washing against these unstabilized areas.

As noted by van de Kreeke and Wang (1984), the multiple openings in this island chain permit good tidal exchange with Units V and VI to the south. However, the existence of the deep borrow channel to the north of the islands and almost total vertical bulkheading of these man made islands are factors that may increase turbidity in this area. Wanless et al (1984) have observed the erosion of the dredge cuts on the north side of

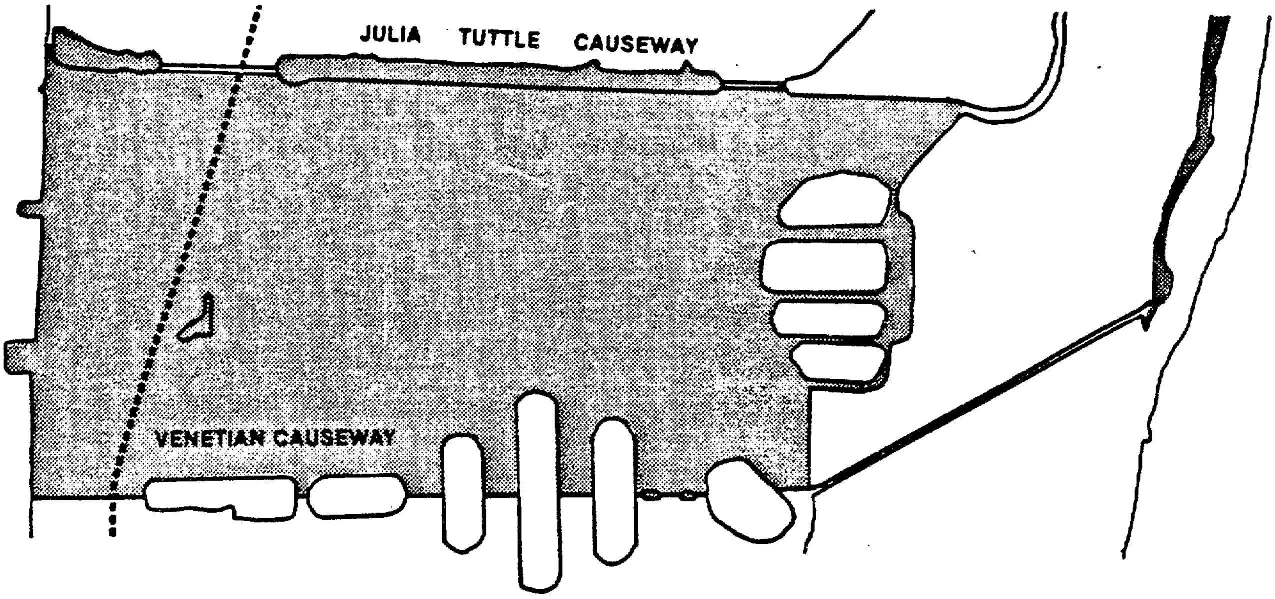

FIGURE 75
UNIT IV

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

the borrow area and the continual scouring of this dredge area. The forces of wind and boat generated waves reverberating off the vertical bulkheads cause the seawalls to crack and allow the contained fill to erode away. This not only exacerbates the problem of turbidity in this area, but it also necessitates costly repairs to seawalls, upland areas and shoreline pools.

Poorly stabilized sediments in the open, relatively deeper areas, are re-suspended by winter storms that come from the east or west. Northerly winds bring turbid waters into the area from the units to the north. An area of high turbidity is located southwest of Sunset Isle Number Two when heavy winds come from the northeast (see Figure 26). High turbidity is observed in the eastern and southeastern portions of the unit when there are heavy winds winds from the northwest (see Figure 27).

Tidal currents flush most of the bottom sediments from the dredged troughs in the southern and southeastern part of this unit to the point that there is only a thin veneer of sand over the bedrock in these areas. In contrast, some sediment accumulation occurs in the less exposed barren areas in the western part of this area.

Current flows between Units III and IV are constrained by the openings in the Julia Tuttle Causeway. Due to the many openings in the Venetian Causeway, the flow tends to spread across the southern part of the unit, with a streamline generally separating the more easterly from the westerly currents running north from Di Lido Island. This pattern creates a stagnant area just south of the middle of the Julia Tuttle Causeway (van de Kreeke and Wang, 1984).

Modeled residence times for Unit IV were 3.5 days, based upon tidal flows only; 5 days with a south wind added to tidal currents; and 2 days with a north wind added to tidal flows. This figure corresponds quite well to measured residence times of 4.6 days (van de Kreeke and Wang, 1984). Modeled tidal currents increase from nine inches/second in the north of the Unit to fifteen inches/second in the south (Wang and van de Kreeke, 1984).

Historical Background

According to the 1887 U.S. Coast and Geodetic Survey, the area between the Julia Tuttle Causeway and the Venetian Causeway was surrounded by more than four miles of mangrove forests along the shoreline. A 1914 map (see Figure 76) shows the mainland as already partially developed from Buena Vista south to the Collins Bridge, which was opened to traffic in 1913. However, on the Miami Beach side, only the southernmost part of the area in the vicinity of Collins canal was developed with a roadway grid. The rest of the Miami Beach shoreline is shown as heavily vegetated by mangroves in 1914.

In 1925-26, the Venetian Causeway was built at a cost of \$1.5-\$2 million to replace the old Collins Bridge. This causeway was privately owned and operated until 1950, when it was purchased by Dade County. By 1925 the Venetian Islands had been bulkheaded and filled. At the eastern end of the Venetian Causeway, the natural Bull's Island was filled, bulkheaded

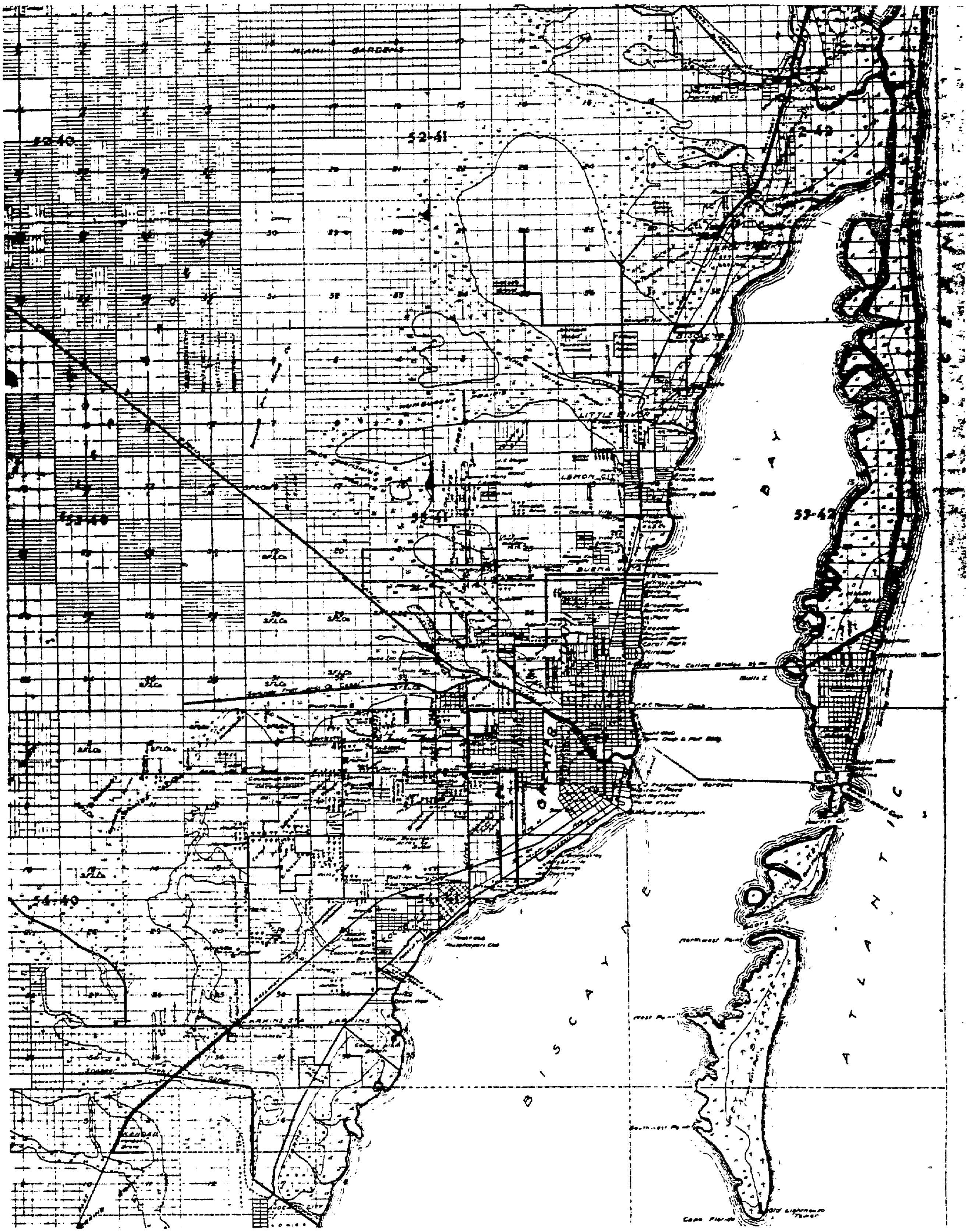

FIGURE 76

1914 LOCATION MAP OF A PORTION OF DADE COUNTY, FLORIDA

SOURCE: RICHESON LOVE, DELINEATOR
HISTORIC MUSEUM OF SOUTHERN FLORIDA MAP FILES

and renamed Belle Island. By 1928 the Sunset Islands had also been created in an area that had formerly been mangrove islands and Bay bottom.

By 1925, over ninety-two percent of the surrounding area had been filled and the only mangroves that remained were in the vicinity of the present Sunset Islands. Extensive filling and bulkheading brought about a 56 percent increase in linear miles of shoreline during the period from 1887 to 1976, largely as a result of the Venetian Isles construction in the 1920s and the development of the Julia Tuttle Causeway in the early 1960s. Filling and land development also brought about an 11 percent decrease in open water area in the period between 1925 and 1976 (Harlem, 1978).

Changes Since 1974

While most of the massive changes that created the shape and character of this area took place during the boom years of the 1910s and 20s, several notable changes have taken place in this area since 1974. On the mainland side the Charter Club and Bay Point were constructed just south of the Julia Tuttle Causeway. Floating docks were put in at the Charter Club, but they have not been replaced since being destroyed during a storm several years ago. The inlet at NE 28 Street has been cleared of most of the derelict vessels that were "moored" or abandoned there and the northwestern edge of the inlet has been cleared and bulkheaded.

The most notable development adjacent to this Unit has taken place at Omni, Plaza Venetia and Marriott Hotel. The development of the Marriott Marina (formerly Plaza Venetia) involved a protracted land lease/coastal permitting process. As part of the permitting process, the developers were required to place riprap boulders under the docks to improve intertidal habitat and water quality in this area.

Since 1980 the County has required retention of the first inch of storm water runoff on site when any redevelopment occurs. As a result of recent road improvements and redevelopment, six of the twenty-three storm water outfalls larger than 12 inches in diameter that drain into the western part of Unit IV, from the area east of Biscayne Boulevard, have been upgraded by the City of Miami or private developers to meet the County requirements.

On the Venetian Islands, highly visible redevelopment has taken place on Biscayne Island on the west and Belle Island on the east. Most of the changes on Belle Island will be discussed in the next chapter, as they have occurred on the southern part of the Island which is within Unit V. On the northwest side of Belle Island, several structures were torn down in 1984-85.

On the beach side of this Unit, notable changes have taken place at the old marina site at the base of Purdy Island. The marina was closed in the mid-1970s and subsequently blown up as part of a movie set. The adjacent land was also cleared in the mid-1970s, but redevelopment of this site has not occurred due to prolonged litigation.

To the south of the old marina site, the City of Miami Beach opened Island View Park in 1985. This 3.3 acre mini park features a VITA course, picnic area, seating areas along the Bayfront and parking lot. City officials expect that this park will be used during the week as a quiet lunchtime exercise and dining area and on weekends by residents of the adjoining neighborhoods. The entire project is slated to cost $775,000. A $175,000 grant from the State of Florida Department of Natural Resources, was used for construction of the VITA course, parking lots and landscaping. Construction of a boat ramp, seawall and Marine Patrol facility is scheduled to begin as soon as funding becomes available.

Coastal Construction. During the period from June 1980 through October 1985 there were 52 applications submitted to DERM for coastal construction activities in Unit IV. Forty-six applications were approved for work including 38 docks, three marinas, six seawalls and two riprap permits, one dredging project and 3 cable laying operations. The total estimated cost of the work done within this unit was estimated at over $535,000. This figure does not include the two million dollars with of Christo's Island work (spread over Units I-IV) that was also permitted by DERM.

Unit IV - 1986

Unit IV is bordered on the north by the Julia Tuttle Causeway, on the west by the one and one half miles of mainland shoreline area known as Edgewater, on the south by the Venetian Islands and on the east by the Sunset Islands and Miami Beach.

Because of its expanse and location, the Julia Tuttle Causeway affords several unique possibilities for improving the quality and utility of the Preserve in Units III and IV. Sixty thousand motorists who cross the Julia Tuttle Causeway each day are treated to some of the most spectacular waterfront views to be seen anywhere in Dade County. Although fenced and not officially open to public use, the causeway is recognized by local fishermen as a good location to catch snook and trout (Hardie, 1983).

Recognizing the enormous potential that this facility has for improving public access to the Bay, Metro-Dade County developed a master plan for construction of ingress and egress lanes from the highway, a circumferential roadway, landscaping, recreational facilities and habitat improvements. The Board of County Commissioners appropriated funds for roadway construction in 1983 and additional funds were sought from State and Federal sources for construction of a sail and small boat launching area, boardwalks and viewing areas, picnic shelters and restrooms. A fishing pier was planned to provide access to the artificial reef that has been constructed in the deep borrow pit on the northwestern side of the large island. Approval from the Federal and Florida Departments of Transportation, additional funding and citizen support must be sought in order to make this plan a reality.

Edgewater. The one and one-half mile mainland shoreline area east of Biscayne Boulevard is known as Edgewater. This is a transition zone between the downtown central business district and the more stable residential areas to the north. The linkage of this area to the downtown central business district is dramatically demonstrated by the high proportion of commercial property, which account for 54 percent of total real property values in this area. These figures reflect the concentration of retailing at the west end of the Venetian Causeway as well as the general commercial orientation of Biscayne Boulevard. Single family homes represent only about five percent of total assessed values compared to about 40 percent Countywide. Only about 4 percent of the Edgewater area is undeveloped (Metro-Dade Planning Department, 1980). Although this area was developed in the 1920s, about 50 percent of the assessed property values in the area are on buildings constructed since 1970, mostly at or near the shoreline (Metro-Dade Planning Department, 1980).

Throughout most of the Edgewater area north of Pace Park, road alignments and past development practices have limited public shoreline access. The twelve streets that dead end at the water's edge could be important public access points, with street end piers, as seen in other cities in Florida. This, however, has not happened in the Edgewater area.

The main public access point along the western shore of Unit IV is the City of Miami's Pace Park. This twelve acre park is largely open, unshaded and undeveloped except for a VITA course. The City of Miami Parks Department has developed plans for landscaping, shelters and a picnic pavilion. Except for the planting of some palm trees these facilities have not been constructed due to opposition from nearby residents. The approximately 2,000 feet of shoreline at Pace Park is eroding. Because of prevailing winds, trash and litter also accumulate along the shoreline and in the shallow cove to the north making this park much less attractive than it could be.

Recent developments at Plaza Venetia and the Marriott Hotel have provided public walkways and shoreline restaurants that overlook the water and marina. However, the siting and design of the massive buildings have virtually obliterated views of the Bay for passing motorists.

Venetian Causeway. From 1974 through 1986, land uses along the Venetian Causeway remained quite stable. The middle four islands are entirely devoted to single family homes. Belle Isle, the easternmost of the Venetian Island chain, is primarily developed in high density uses. On the western side, Biscayne Island underwent substantial redevelopment during the period from 1978-86.

Development patterns along these islands are such that the passing motorists get only fleeting glimpses of the Bay while crossing the bridges between the islands. Direct public access to the Bay is very limited. In addition to problems that are related to shoreline treatment, twenty-four storm water outfalls larger than twelve inches in diameter drain street and yard runoff into the Preserve from the six Venetian Islands (see Figure 77).

Although officially closed to fishing by local ordinances, the bridge areas along the Venetian Causeway provide some good fishing for snook and

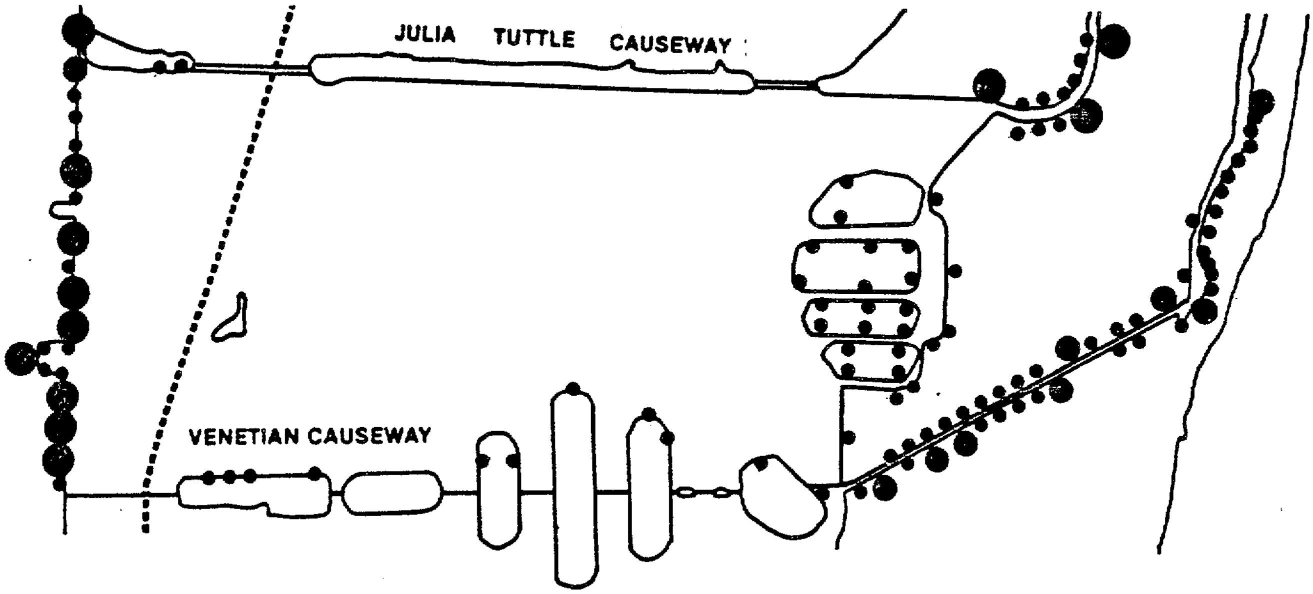

FIGURE 77

STORM WATER OUTFALLS

- ● ≥ 30″
- ● 24-30″
- • 12-23″

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

trout. Shoreline anglers fish the Miami side of the Venetian drawbridge, while boaters fish the other spans (Hardie, 1983).

Barrier Islands. Like the Venetian Islands, the Sunset Island area is almost entire devoted to single family residential uses. The only public access to the Preserve in this area is provided by the City of Miami Beach's new Island View Park.

The development pattern not only severely restricts public access to the Preserve from this part of Unit IV, but also affects the quality of the Preserve. There are thirty-four storm water outfalls that drain the roads and lawns of the Sunset Islands and the western part of Miami Beach, including the Bayshore Municipal Golf Course, into the Preserve (see Figure 77). As noted previously, the reflection of boat wakes off bulkheads causes re-suspension of bottom sediments. Wanless et al (1984) observed that the turbid embayment to the north of Sunset Island Number One is the major sediment sink, or accumulation area, for this entire unit.

In-Water Activities . This Unit contains over three miles of protected waters. Figure 78 indicates the variety of in-water activities that take place within this Unit. The Intracoastal Waterway (ICW), parallel to the mainland shore, and Meloy channel, along the Miami Beach side, provide direct north-south routes through this area. East/west navigation across this basin is constrained by the pilings of 'Pelican Island.' The concrete pilings and metal reinforcement rods at this location form a 1/4 mile wide rectangle which extends three quarters of a mile southward from the Julia Tuttle Causeway, in the center of this basin. Navigation through the pilings is almost impossible. There is only an 800 foot wide gap between the southernmost border of 'Pelican Island' and DiLido Island. This seven to eight foot deep area serves as the east/west link between the ICW and Meloy Channels.

The Island Queen out of the Hyatt/Knight Center and several other tour boats from Nikko Gold Coast Cruise Lines at Haulover Park run Millionaires Row' tours off the Venetian Islands several times a day. However, there is not much other boat traffic along this route. To the south in Unit VI, the ICW and Meloy Channels link up to Government Cut Channel which is the major outlet to the Ocean.

Boating activities within Unit IV are not limited to large boats utilizing the ICW, Meloy Channel and dredged areas. The area between the Pace Picnic Island and the pilings of 'Pelican Island' is heavily used by sailboaters. This is the location of the nationally known Miramar Course, a multi-hull sailing race course named after a hotel that was located in the Edgewater area from which people used to watch the colorful races. This area has brisk and consistent prevailing winds and an open expanse of shallow and flat waters. Miami Yacht Club and nationally sanctioned sailboat races are held here throughout the year because of these near ideal conditions. Hobie Cat sailors utilize the Pace Picnic Island and multi-hull sailors utilize the sand flats north of Pace Picnic Island to beach their boats and rest between races.

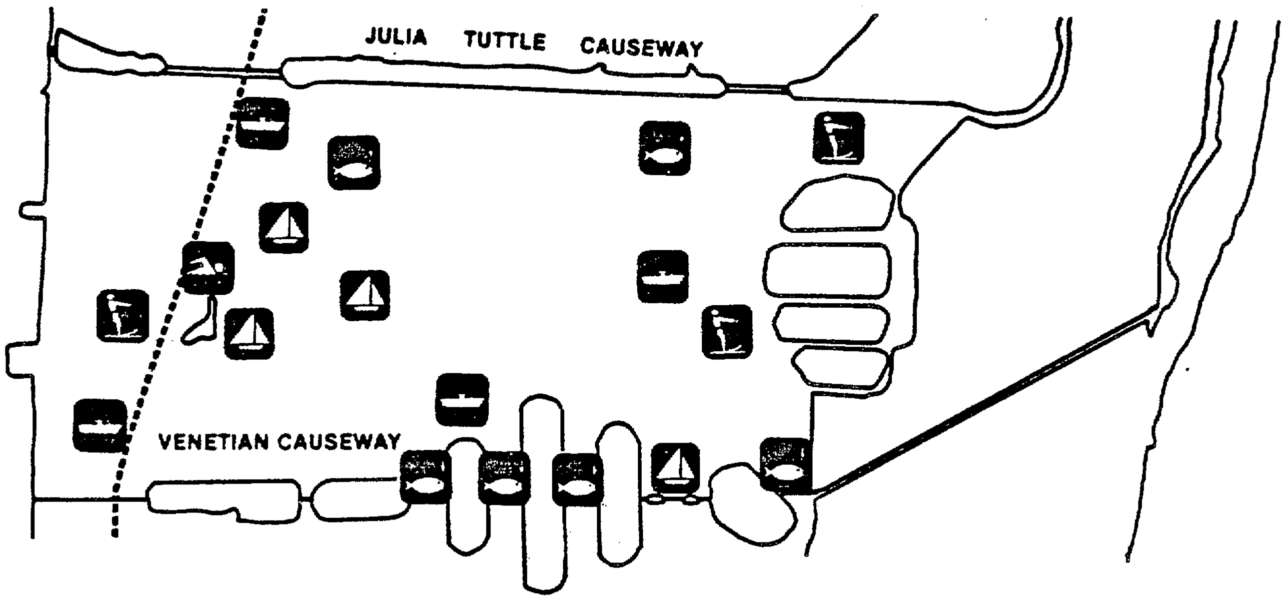

FIGURE 78

IN-WATER ACTIVITIES

SOURCE: METRO-DADE PLANNING DEPT., 1986

While the wide open shallow water is good for multi-hull racing, the shoals limit waterskiing within Unit IV to deeper dredged areas in the lee of Miami Beach and on the western side of Pace Picnic Island. These areas are protected from the wind, and the waters are deeper than in the center of the basin. The western side of Pace Picnic Island is also used for boat anchoring and swimming. This island and the area around it are heavily utilized on weekends, particularly by powerboaters.

Fishing from boats also takes place in this basin, especially off the southeastern end of the Julia Tuttle Causeway west of the Meloy Channel. This shallow seagrass area is a well known trout flat (Martin, personal communication, 1984). Although the Julia Tuttle and Venetian Causeway bridges are officially closed to fishing, stationary shoreline fishing is also common in this area. Night fishing off these causeways offers some of the Bay's best trout and snook fishing (Hardie 1983).

In February 1986, a total of about 250 boats were docked in Unit IV (Metro-Dade Planning Department, 1984). About 150 were berthed or on davits at Plaza Venetia Marina (see Figure 79), with the remainder docked at private bulkheads along the Venetian Islands and the Sunset Islands of Miami Beach. Assuming that each private home along the Venetian and Sunset Islands and Miami Beach could berth one boat and assuming full capacity at Plaza Venetia Marina, there are potentially 350 additional berthing spaces in Unit IV (Metro-Dade Planning Department, 1986). This figure does not include proposed, but unpermitted, slips at Bay Point, NE 27th Street and Biscayne Islands, nor does it include the bulkheaded mainland shoreline.

Because of prevailing wind conditions, as well as boat wakes along the ICW, the western shoreline of Unit IV is not well suited for docking boats. This is evidenced by the fact that only one boat was docked along the private bulkheads on the mainland shore. Several years ago pilings were driven and docks installed just south of the Julia Tuttle Causeway, at the Charter Club. The pilings are still in place, but the docks have since been washed away. Except for the Mariott Marina, the mainland shoreline stands out because of its lack of docking facilities as compared to other developed areas of north and central Biscayne Bay.

Submerged Lands. The most interesting aspects of submerged lands in this area are related to ownership. As shown in Figure 80, the Bay bottom lands along the western half of the area are vested in the State of Florida; although this ownership pattern has not been verified by the Division of State Lands, which acts as the staff arm to the Trustees of the Internal Improvement Trust Fund. The spoil islands and adjacent lands along the Julia Tuttle Causeway are owned by Metro-Dade County, although the highway itself is an interstate ppur which is under the direct control of the Federal Department of Transportation. The spoil islands adjacent to the ICW are deeded to the City of Miami for recreational purposes, however, the U.S. Army Corps of Engineers retains spoil easements over these islands which means that their permission must be sought if any changes are to be made on or adjacent to these islands. Jurisdiction over maintenance of the ICW for navigational purposes also resides with the U.S. Army Corps of Engineers.

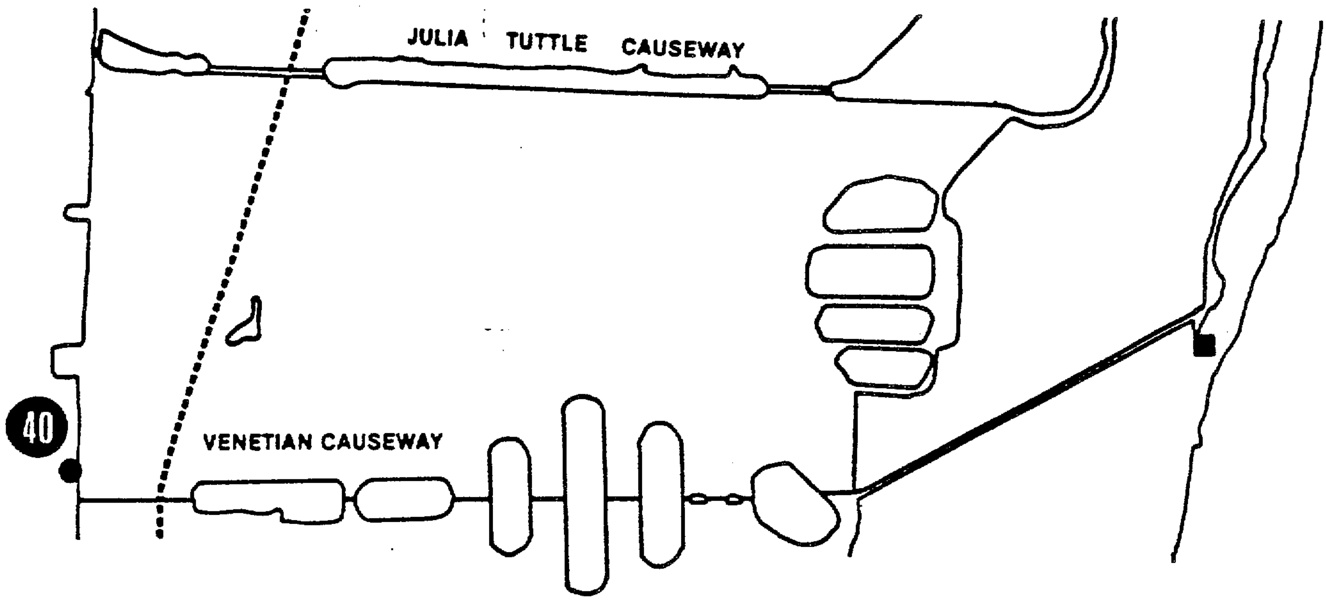

FIGURE 79

MARINA LOCATIONS

● WITHIN APMA

■ ADJACENT TO APMA

ANCHORAGE AREAS

SOURCE: METRO-DADE PLANNING DEPARTMENT, 1986

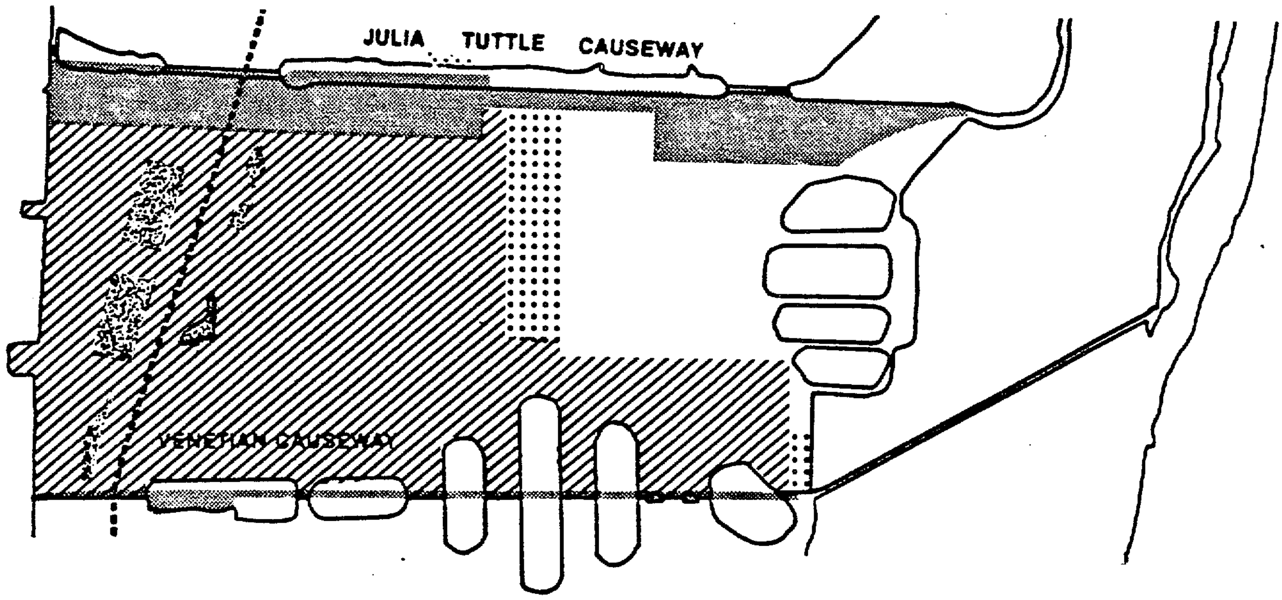

FIGURE 80

LAND OWNERSHIP PATTERNS

FEDERAL
STATE
COUNTY
CITY OF MIAMI
CITY OF MIAMI BEACH
SPOIL ISLANDS & SPOIL ISLAND EASEMENTS

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCE: CITY OF MIAMI BEACH, 1985
CITY OF MIAMI PUBLIC WORKS DEPT., 1969
METRO-DADE PUBLIC WORKS DEPT., 1977 & 1981
METRO-DADE PARK & RECREATION DEPT., 1986
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1977

On the southern boundary of this area, the Venetian Islands are privately owned, however, the roadway right-of-way and the strip of land on the southwestern end are owned by Metro-Dade County. The adjacent submerged land has been retained in State sovereignty ownership. Most of the submerged land area south of the Julia Tuttle Causeway and north of Sunset Island #4 is in private ownership. All of the submerged lands within this Unit are either under the jurisdiction of the City of Miami or the City of Miami Beach.

The Bay bottom in this area is used for pilings, channel and spoil easements and cable crossings. The most noteworthy of the pilings are the concrete posts which outline 'Pelican Island,' which derives its name from the frequent use of these posts by pelicans and other birds. As discussed previously, the major channels through and across this area are the ICW and the dredged borrow areas bordering the Sunset and Venetian islands. The only marked cable crossings are between the mainland and Biscayne Island, to the north of Biscayne Island, between Biscayne Island and San Marco Island and between Rivo Alto Island and Belle Island.

UNIT IV

MANAGEMENT OPPORTINITIES

The management opportunities listed below indicate locations where the general recommendations at the end of Chapter 1 can be implemented in Unit IV. They are grouped under four general headings: Water Quality, Resource Conservation, Vessel Storage and Use, and Public Access. The numbers listed below correspond to those shown on Figure 86 on page 225:

Water Quality

1. Storm Water Outfalls. From the standpoint of size alone, the three large storm water outfalls that discharge into the Biscayne Waterway and the eight outfalls larger than 30 inches in diameter that discharge into Biscayne Bay on the mainland side should be retrofitted to minimize the impact of the first inch of runoff on the waters of the Preserve.

2. Embayment North of Sunset Island #1. A study should be undertaken to learn more about the causes and feasibility of abating the high levels of turbidity in this area.

3. Unstabilized Submerged Spoil Areas and Cuts. The channel and borrow pit along the southeastern side of this unit should receive priority for stabilization, if a cost effective, environmentally sound means can be identified to accomplish this end.

4. Pace Park. In the near term, the shoreline erosion should be corrected and the inlet immediately north of the park site should be cleaned out.

5. Pace Park Spoil Island. There should be more frequent cleanup of this heavily used picnic island.

6. Canal Cleanup. The City of Miami Beach should institute a canal cleanup program similar to those of Metro-Dade County or the City of Coral Gables.

Resource Conservation

7. Pelican Island. All state and locally regulated activities should uphold the City of Miami Beach's designation of Pelican Island as an aquatic recreational open space area where no development should be allowed.

8. 'Pelican' Island Pilings. In 1984 the Bay Policy Advisory Committee recommended that funds be sought to have the pilings removed and that the U.S. Coast Guard place appropriate markers to prevent the boating public from running aground and destroying the shallow grass beds to the east of Pelican Island. However, staff recommended that the pilings be left in place as they do no environmental damage. The pilings limit east-west boat traffic, thereby serving the function of protecting the grass beds to the west of the Sunset Islands.

5. 'Pelican Island' Demonstration Project. A portion of the Pelican Island site should be studied to determine whether it is desirable and cost effective to partially fill a barren Bay bottom area to the point where light may penetrate to the bottom, thereby promoting the colonization of benthic vegetation.

Vessel Use and Storage

10. Old Miami Beach Marina Site. This area should be rezoned to encourage mixed townhouse/water oriented commercial use. Because of the physical conditions, the old Turchin marina site should be given strong considerations as a future marina site, providing that it is done with adequate environmental safeguards and site design considerations that minimize noise or physical intrusions for the property owners on the south side of Sunset Island #4.

Public Access

11. Julia Tuttle Causeway. The conceptual plans that have been developed by Metro-Dade County should be implemented. Final approvals, funding, municipal and citizen support for this multifaceted habitat and public access improvement project should be given very high priority by all appropriate levels of government.

12. Old Miami Beach Marina Site. The upland portion of this site should be zoned to encourage mixed townhouse/water oriented commercial uses.

13. Pace Park. Long term plans should be developed for more water oriented use of this park and the inlet to the north.

14. Inlet at NE 28th Street. The debris should be picked up along the City of Miami right-of-way and the derelict vessels removed. This site should be considered for neighborhood access to the Preserve and as a location for small boat access. The southeastern corner would be an ideal location for a commercial water oriented facility such as a restaurant.

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CHAPTER 6

UNITS V AND VI

The Venetian Island Causeway to the MacArthur Causeway and The Port of Miami

Introduction

Unit V is bordered on the north by the Venetian Causeway, on the east by the Miami Beach shoreline from Dade Boulevard Canal to the MacArthur Causeway, on the south by the MacArthur Causeway and on the west by the Miami Herald Building and parking area, which lies between NE 13 and NE 15 Streets in the City of Miami. All of the water area and publicly owned uplands within this area are governed by the provisions and jurisdiction of the Biscayne Bay Aquatic Preserve Act.

Unit VI is primarily Government Cut Channel. This Unit is bordered on the north by the MacArthur Causeway, on the east by the southern tip of Miami Beach, Government Cut and Fisher Island, on the south by the Port of Miami and on the west by Bicentenial Park and the old Florida East Coast property in downtown Miami (see Figure 81).

The area between the Venetian Causeway and the MacArthur Causeway (Unit V) consists of about one and one-half square miles of open water. Because of the extensive filling and creation of islands, this Unit is surrounded by almost twelve miles of linear shoreline, 78 percent of which is vertically bulkheaded. The remaining 22 percent on Watson Island and the MacArthur Causeway is unconsolidated. Water depths in this area average more than 10 feet at mean low tide and only four percent of the Bay bottom has any vegetative cover. DERM permitting surveys have documented the presence of important hard bottom communities growing adjacent to bulkheads in this area. At Venetian Harbor, the south seawall and adjacent area was observed to support a diverse hard bottom community. However, it is not known how extensive these hard bottom communities may be along the bulkheaded or riprapped portions of Units IV - VII that are well flushed with ocean waters.

Unit VI is border by more than eight miles of man-made shoreline. About 50 percent of the shoreline is vertically bulkheaded, 42 percent is unconsolidatd, primarily along Lummus Island, and eight percent is riprapped, along the mouth of Government Cut. Prior to the Port expansion, thirteen percent of the shoreline in Unit VI was bordered by a thin marginal mangrove forest on Lummus and Sams Islands. This area is entirely dredged to depths that average more than thirty feet.

Turbidity in Units V and VI is midrange between the low values observed in the southern part of Unit VIII and the high values at the nodal point in Unit II. Wanless et al (1984) observed that there is little benthic sediment production in the area. Except for a few shallow vegetated areas, the Bay bottom in this area has only a little sand or muddy sand over the bedrock. Therefore, there is only a limited amount of natural sediment available for re-suspension on a day-to-day basis. Wanless

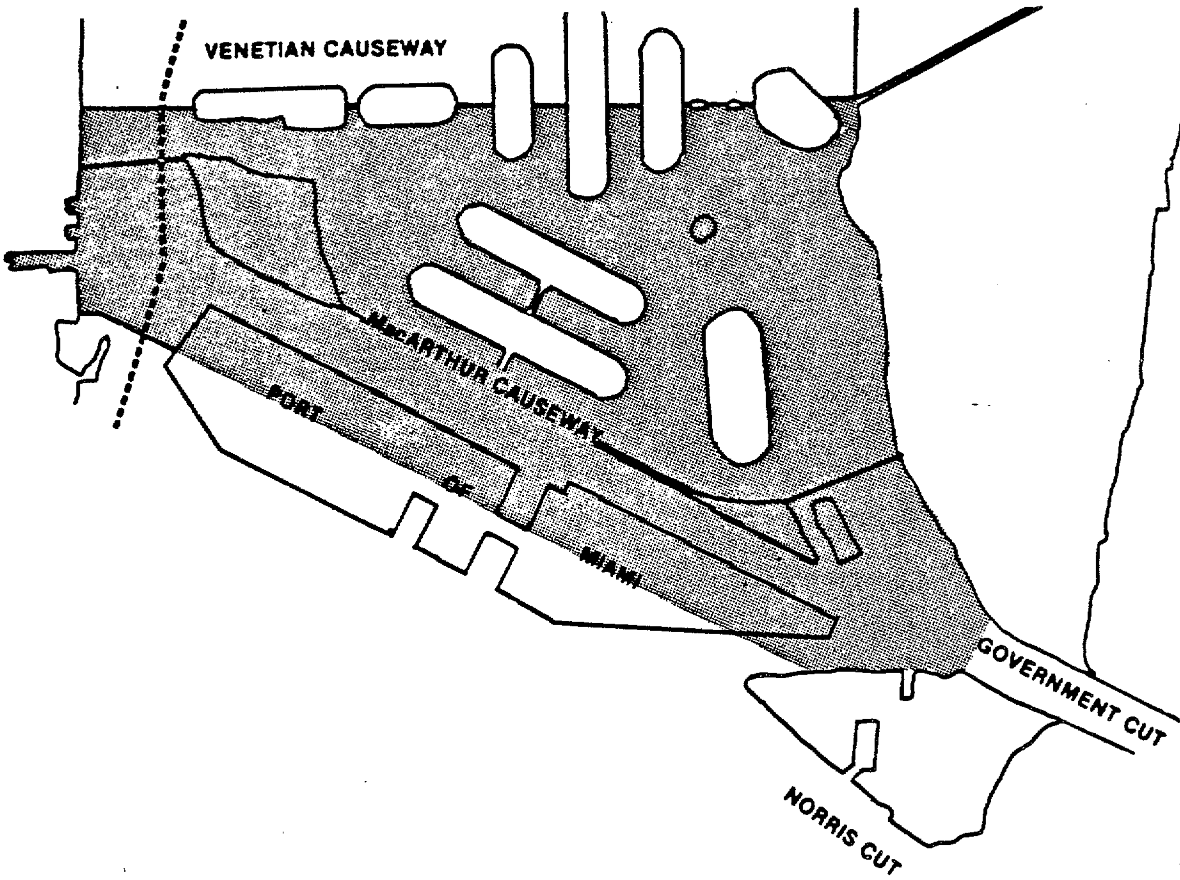

FIGURE 81
UNITS V & VI

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

et al (1984) concluded that there are no sediment sinks in this area and that most of the sediment that comes into this area is swept out of Government Cut, accumulates in the turning basin or settles into the spaces in the rubble along the eastern part of the Unit. This observation was corroborated by Wang and van de Kreeke's (1984) calculation that it takes less than one day for particles suspended in the water column in Units V and VI to be flushed out of the Government Cut Channel (see Table 1).

Historical Background

This two and one half square mile area has been subjected to the most long standing and drastic changes of any part of the APMA. Massive dredging and filling transformed this formerly shallow estuarine area into an urbanized land area surrounded by a heavily used water body.

In 1887, there were almost two miles of mangrove forest shoreline bordering the area between the present day Venetian and MacArthur Causeways (Unit V). The forests were still quite extensive prior to the filling of Miami Beach in the late 1910s but they were totally obliterated from this area by 1925. Intensive development permanently altered 77 percent of the unit prior to 1925 (Harlem, 1979). In the process, the water area was diminished and the amount of linear shoreline was increased dramatically.

In the early 1900s, between 9th and 11th Streets on the mainland there was a cove with a white sand beach. This area was used by fishing boats. By the 1920s the white sand beach had disappeared and the fish houses were rundown. After the fish houses were razed in 1925, two municipal piers were built at this location.

The fill from the successive dredgings of the Government Cut Channel was first used to develop the County (MacArthur) and Venetian Isles Causeways. Later, the fill was deposited over grassy areas to form what eventually became Dodge, Lummus and Sams Islands. Since no devices were used to contain siltation, the area between the Cut and adjacent areas were heavily silted for long periods of time after the actual dredging was done.

In 1912 the Florida East Coast Railroad Company built two finger piers between 6th and 9th Streets on the mainland side of the Bay and redredged the ship channel. By 1927 the ship channel had been dredged to 26 feet, but several steamship lines operating out of Boston and New York bypassed Miami because of the shallow channel. With subsequent dredging to 35 feet in 1938, the Port of Miami became the third busiest cruise port in the United States. Between the end of World War II and 1956, Port operations were severely constrained by the size and location of the 36 acre site on Biscayne Boulevard.

In 1957, the operation of the Port was taken over by the new Metropolitan Dade County government and in 1959 Metro announced that the string of spoil islands, created from the dredging of the ship channel, would form the basis for the new Port of Miami. Created at an original cost of $15.3 million, the new Port of Miami on Dodge Island opened for business in 1964. The rapid growth of the new 21-30 berth facility was exemplified by the fact that the projections made in 1969 for the year 1985 were surpassed in 1973.

Changes Since 1974

Although this area was dramatically altered during the early boom years, several impressive changes have taken place in and adjacent to this area since 1974. Certainly the most notable is the expansion of the Port of Miami. In 1979, the Port initiated a 295 acre, quarter billion dollar expansion. By 1985, Lummus and Sams Islands had been filled and expanded to 227 acres, the main shipping channel and turning basin had been dredged to 36 feet, and three gentry cranes had been installed on the southeastern end of Lummus Island.

Along the western shoreline, the northern slip at the old port was filled during 1973-74 as was the larger slip in the Florida East Coast (FEC) property to the south. Except for occasional visiting vessels, the remaining slip at the old FEC property has not been used for dockage since the mid-1970s when the TMT line closed down its containerized shipping activities from this site. By 1976, the old port area had been landscaped and rededicated as Bicentennial Park.

Across the Bay, permitting for the South Shore Marina on Miami Beach was actually initiated prior to the adoption of the Biscayne Bay Aquatic Preserve Act in 1974, but this 400 slip marina was not completed until 1985. To the south, South Pointe Park was opened along Government Cut on the southern tip of Miami Beach. The property was formerly held by the U.S. Army Corps of Engineers and deeded to the city in 1979 under the original South Shore Redevelopment Plan.

The 17-acre South Pointe Park includes a restaurant, an amphitheater, bicycle path, observation tower, athletic field, parking and picnic areas, VITA course, tot lot, and a dune preservation area. The project was funded by a grant from the U.S. Department of the Interior Land and Water Conservation Fund (LAWCON), administered by the State of Florida, and matching city funds.

Elsewhere in Unit V, on Biscayne Island, a high density development, Venetian Harbor was built where a number of low rise residential apartment buildings were located in 1974. The developers of Venetian Harbor cleaned up and landscaped the portion of the right-of-way adjacent to their condo. However, this area is being used as a neighborhood mini park with benches, trees, and paved running paths. A new condominium and a 36 slip marina were constructed at Nine Island Avenue on Belle Isle and an existing marina at Costa Bravo was expanded to 30 slips.

Coastal Construction. During the period from June 1980 through October 1985 there were 39 applications submitted to Dade DERM for coastal construction activities in Unit V. Thirty-one applications were approved for work including 24 docks, two bridge construction/repairs, eight seawalls and two marinas. The total estimated cost of the work done within this Unit was about three hundred thousand dollars, excluding work done at the Port of Miami.

In Unit VI during this same time period, there were 15 applications, 11 of which were approved. The permitted work cost an estimated $4,122,440.

Units V and VI - 1986

Along the Venetian Causeway, the northernmost boundary of Unit V, the man-made residential islands form several distinct subdistricts. Starting on the west end of the causeway, Biscayne Island's southern shoreline is developed at medium to high residential density. The 1500 by 100 foot public right-of-way on the southeastern end of Biscayne Island has been reserved for future use if the Causeway should ever need widening. However, this area is being used as a neighborhood mini park. The only feature lacking is parking, and hence, the privately developed park can only be used by nearby residents.

Rivo Alto, DiLido, San Marino, and San Marco Islands form separate exclusive single family residential enclaves. Belle Isle is mostly developed in high-rise, high density residential development. As shown on Figure 82, most of these islands have storm sewers which drain the storm water into the Bay. One can assume that storm water from areas not serviced by storm sewers still ends up in the Bay.

Miami Beach. The man-made Bay shoreline of Miami Beach from the Venetian to MacArthur Causeways creates a distinct waterfront edge. This area, known locally as "condominium row," is characterized by an extremely heavy concentration of high density, high-rise developments that wall off the Bay.

From the MacArthur Causeway south, the South Shore Marina dominates the shoreline. Except for a high-rise elderly housing project, other buildings along this shore were removed to make way for South Beach Redevelopment. The City of Miami Beach is working with various developers to obtain a continuous Bay-walk from MacArthur Causeway around the tip of Miami Beach and South Pointe Park to Beach Front Park and the 1.8 mile long promenade on the ocean side of Miami Beach.

There are half a dozen storm sewers over 36 inches in diameter that drain the area from the Venetian Causeway to the tip of South Beach into Biscayne Bay. The drain fields are extensive and in many instances reach as far as the ocean side of Miami Beach. The water quality in this area of the Bay would almost certainly be worse if circulation and tidal exchange through Government Cut were not as strong as it is.

MacArthur Causeway and Islands. Along the MacArthur Causeway, Star, Hibiscus, and Palm Islands form separate and isolated, exclusive, low density residential neighborhoods. Watson Island is City of Miami park land which is split into a variety of uses, some of which provide direct access to the Preserve. On the north side of the island there are two private boat clubs, the Miami Yacht and Miami Outboard Clubs, that lease land from the City. There are also some undermined and dangerous public boat ramps. The Japanese Gardens and a large open green space that is used for soccer and City of Miami Park and Recreation Department activities are located in the central portion on the north. On the south side of Watson Island, Chalk's airways has its terminal and storage areas.

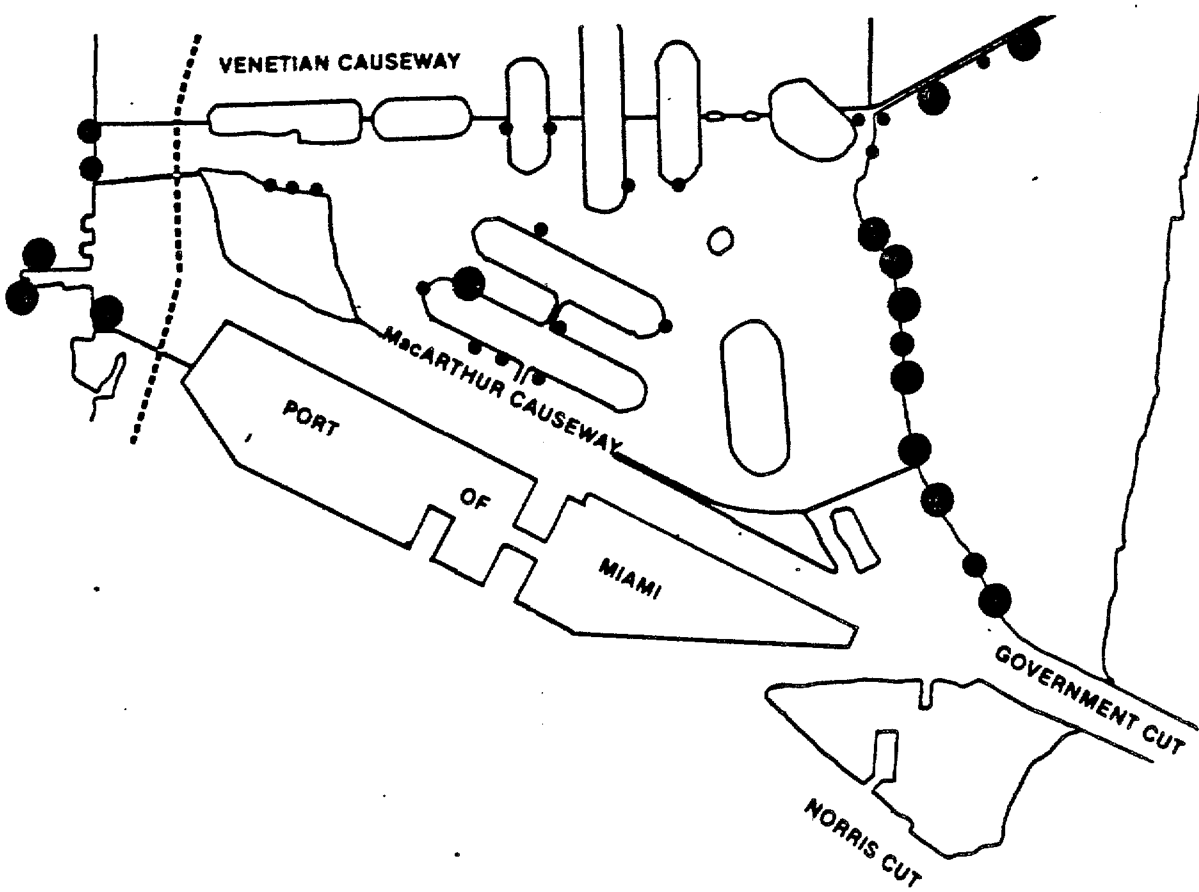

FIGURE 82

STORM WATER OUTFALLS

- ● ≥30″
- ● 24-30″
- • 12-23″

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

Several helicopter companies lease space from the city to run rides from Watson Island. There is a dilapidated marina on the western edge which is being used by the Pier 5 charter fishing boats that were displaced from Miamarina when it closed in 1985.

Mainland. The Miami Herald building is located along the mainland shoreline, between the Venetian and MacArthur Causeways. A barge makes regular deliveries of newsprint to this building via the Bay. South of MacArthur Causeway are Bicentennial Park and the old FEC property. Although placed on prime Bayfront property, the 33 acre Bicentennial Park has been chronically under-utilized and is almost totally non-water oriented. It is used by the Miami Dade Community College baseball team, and was redesigned in 1986 to accommodate the Grand Prix race.

The controversial FEC tract located just to the south of Bicentennial Park, was fought over in court for many years before the City finally gained control of the property. In 1985-86, Miami Motor sports used a portion of the property for the Grand Prix Race, and the City used it as a parking lot. There are several individuals and organizations that are interested in the property including a group that wants to develop a maritime museum and seaquarium, but as of 1986 no definitive plans had been approved.

Port of Miami. In 1986 Dodge Island had 4,300 feet of cruise line berthing space and 4,740 feet of roll on - roll off (ro-ro) cargo berths and was one of the busiest passenger ports in the world. In 1982, the Norway, the largest cruise ship in the world, moved to the Port of Miami and in 1983, 2.7 million passengers passed through the Port of Miami on their way to or from 16 different countries and 27 different ports of call. In 1986, 22 big cruise ships visited the Port of Miami.

In 1981, the Port handled a peak of 2.8 million tons of cargo. Unlike shipping on the River, which will be discussed in Chapter 9, shipping from the Port is more heavily import oriented, than export oriented. The major types of general cargo imported through the Port of Miami are machines, electronic products and consumer goods (the Miami Herald, Business Monday, September 29, 1986). It is estimated that the Port contributes about $2.6 billion to the Dade economy and is directly or indirectly responsible for 40,000 jobs (The Miami News, Money, September 15, 1986).

The next phase of development at the Port of Miami will include dredging the port channels to 42 feet to make the port accessible to the largest classes of cargo ships, construction of three new terminals, installation of two additional gantry cranes, bulkheading of the south side of Dodge and most of Lummus Islands. This will eliminate much of the unstabilized shoreline that is a constant source of high turbidity in this area.

Expansion of the Port has also necessitated replacement of the old low bascule bridge that connects the port to downtown. In the short term, construction of a new 65 foot high bridge will begin in 1988. The fate of the old bridge has not been decided, but Port Director Carmen Lunetta has noted that there is a move to turn it into something "esthetically pleasing," such as shops, fishing piers or small marinas.

Expansion of the port necessitated the destruction of 81 acres of sea grasses and five acres of mangroves on Sams and Lummus Islands. The seagrass planting that was required as mitigation for this destruction of Preserve resources is discussed in Chapter 1.

In-Water Activities. Figure 83 shows different in-water uses that take place within sub-basins in Units V and VI including waterskiing, sailing, power boating, fishing, commercial navigation and seaplane takeoff and landing.

Between the Venetian and MacArthur Causeways, the residential islands jut out into the water, creating many small protected water areas where people water ski. The areas between the islands provide excellent moorages. Courses are also set up by the Miami Yacht Club north of Watson Island. There are a number of residents of the residential islands who own seaplanes and use this area to take off and land their craft.

Flagler Memorial Island has a small sand covered shore on the northwest side which is heavily used on weekends by boaters and picnickers. The rest of the weed and garbage strewn island goes unused. Just offshore of the island, people swim, anchor larger boats, and waterski. A sandy area on the northern edge of Watson Island is a very popular swimming location on weekends.

The basin of water between the MacArthur and Venetian Causeways is used as a water transportation route between the western Intracoastal Waterway and the eastern Meloy Channel. The area is dredged and deep and there are no shallow areas that boaters have to watch out for. Fishing is also a major use which takes place along the MacArthur Causeway as well as on the eastern and western bridges along the causeway.

The Miami Shipping Channel is used as the major water transportation route for freight and cruise ships from the ocean to the Port of Miami and to the Miami River. Chalk's Airways uses the shipping channel for take off and landings, and recreational boats use the shipping channel as a major east/west route across the Bay and to the ocean. Many people gather along the MacArthur Causeway and on Watson Island to watch the large ships, planes, and boats go by. People also fish from on shore of this causeway in the shipping channel and along the riprapped jetty on Government Cut.

Within Unit V there were 140 boats docked at bulkheads in February 1983. Assuming that each private waterfront home adjacent to Unit V could berth one boat, it is estimated that a total of almost 400 boat spaces would be available along the bulkheads. In addition, there are over 100 slips available at six marinas associated with condominiums adjacent to Unit V, however the estimated occupancy rate in February 1986 was only 42 percent. Table 18 and Figure 84 show the marinas with more than ten slips in Units V and VI.

Submerged Land. As shown in Figure 85 most of the submerged land in Unit V has been retained by the State of Florida. The exception is the submerged Bay bottom to the north and east of Watson Island which is owned by the City of Miami. There are cable crossing areas adjacent to

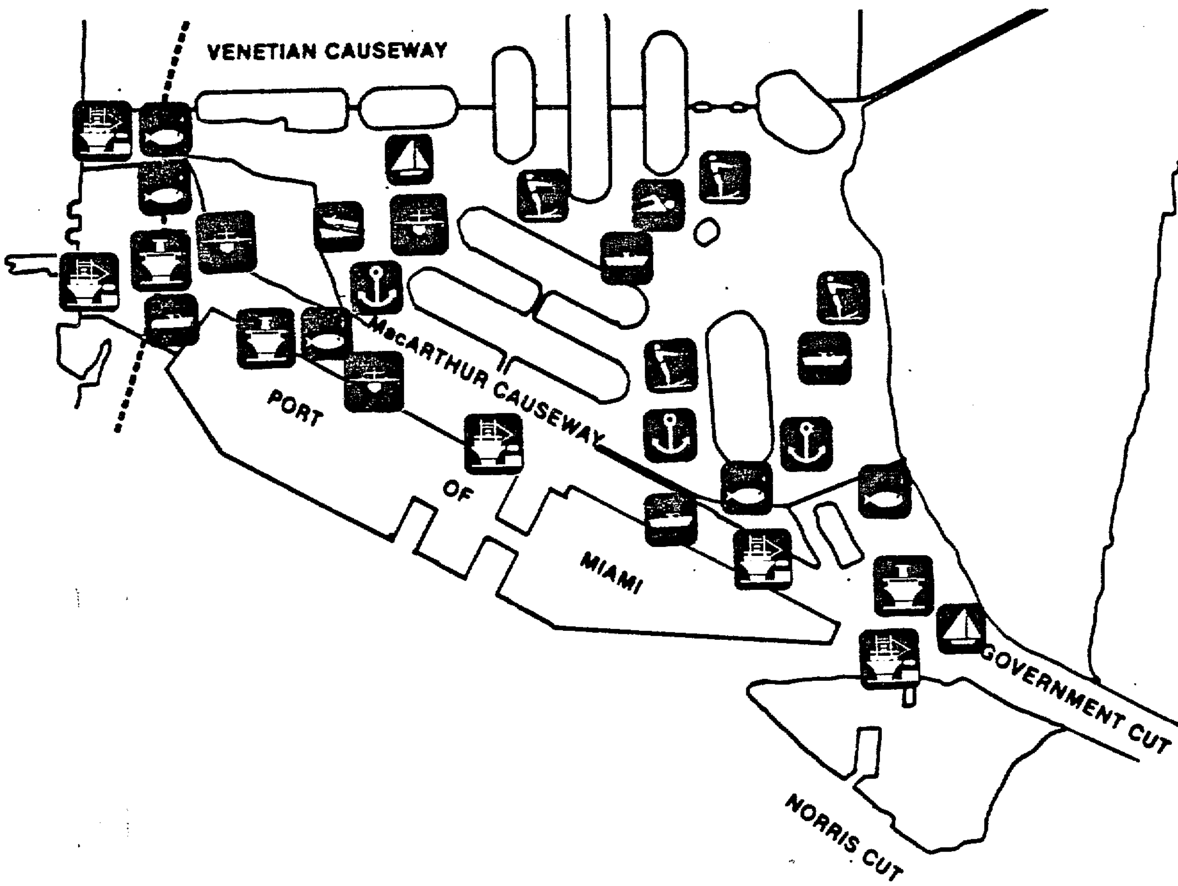

FIGURE 83
IN-WATER ACTIVITIES
SOURCE: METRO-DADE PLANNING DEPT., 1986

TABLE 18

Marina Facilities With More Than Ten Slips
Unit V - Venetian Causeway to MacArthur Causeway and
Unit VI - MacArthur Causeway to the Port of Miami

No.	Type	Facility	Wet	Dry and Surface
41.	Private Club	Watson Island "Miami Yacht Club"	40	100+
42.	Private Club	Watson Island "Miami Outboard Club"	50	80+
43.	Condominium	Belle Isle "Nine Island Avenue"	36	
44.	Condominium	Belle Isle "Costa Bravo"	30	
45.	Condominium	1500 Bay Road, Miami Beach "Morton Towers"	30	
46.	Condominium	1000 West Avenue, Miami Beach "Forte Towers"	26	
47.	Condominium	900 West Avenue, Miami Beach "South Gate Towers"	12	
48.	Condominium	880 West Avenue, Miami Beach "South Bay Club Condo"	17	
	TOTAL Unit V Estimated Occupancy* = 69%		241	180+
	UNIT VI - MacArthur Causeway to Port of Miami			
49.	Public	Southwest side of Watson Island	25	
50.	Commercial	"Miami Beach Marina"	400	
	TOTAL Unit VI		425	
	Estimated Occupancy* = 68% August 1986, excluding Port of Miami			

*Based on February 19 and March 4, 1986 aerial photos, and allowing for 10% vacancy.

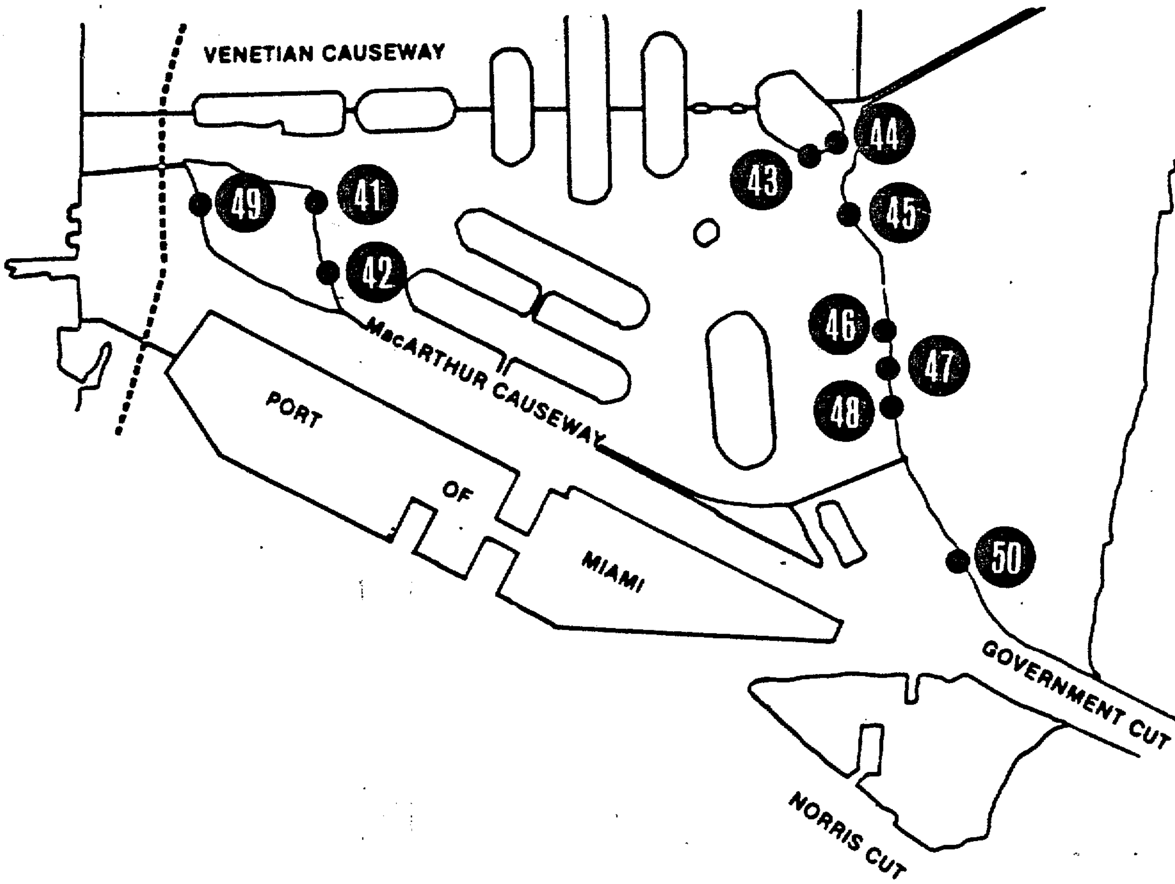

FIGURE 84
MARINA LOCATIONS
SOURCE: METRO-DADE PLANNING DEPT., 1986

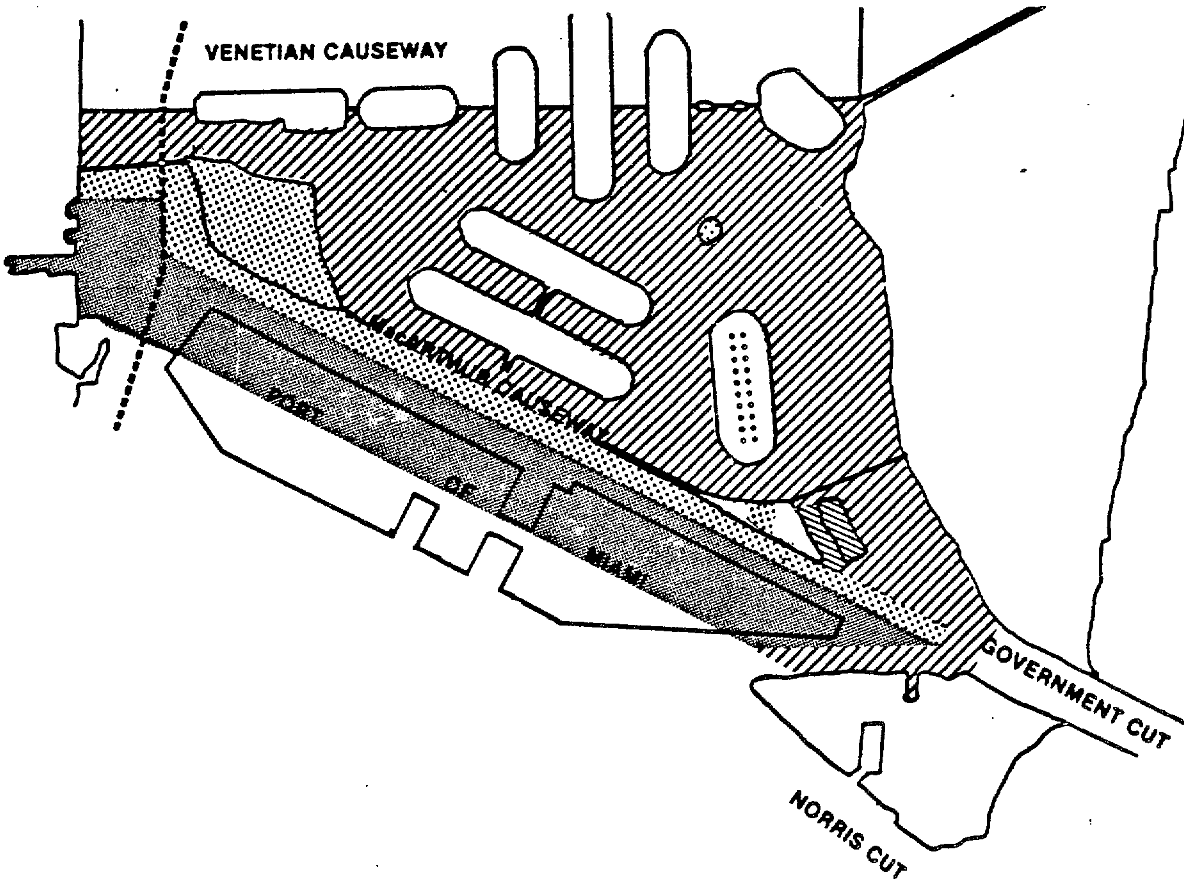

FIGURE 85

LAND OWNERSHIP PATTERNS

FEDERAL

STATE

COUNTY

CITY OF MIAMI

CITY OF MIAMI BEACH

SPOIL ISLANDS & SPOIL ISLAND EASEMENTS

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCE: CITY OF MIAMI BEACH, 1985
CITY OF MIAMI PUBLIC WORKS DEPT., 1969
METRO-DADE PUBLIC WORKS DEPT., 1977 & 1981
METRO-DADE PARK & RECREATION DEPT., 1986
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1977

the eastern end of MacArthur Causeway and along Meloy Channel and between Flagler Monument and Rivo Alto Island, and a pipeline crossing north of Hibiscus Island. The one other notable submerged land use in Unit V is the unused radio tower offshore of the Miami Herald Building. In Unit VI ownership of the land beneath Government Cut Channel is divided among Dade County, the City of Miami and the Federal Government. The berth space adjacent to the Coast Guard Base is also owned by the Federal Government. Only the easternmost portion of Unit VI has been retained in State ownership.

UNITS V AND VI - MANAGEMENT OPPORTUNITIES

There are several locations where the general recommendations listed at the end of Chapter I may be implemented in Units V and VI. These are shown on Figure 86 together with the Management Opportunities for Unit IV. The numbers on Figure 86 correspond to the numbers listed below:

Water Quality

1. <u>Stormwater Outfalls</u>. From the standpoint of size alone, the following storm water outfalls should receive high priority for phasing out or at a minimum redesign to minimize negative impacts: 15th, 13th, 9th and 7th Streets, and at the foot of Alton Road on the Beach side and the western end of MacArthur Causeway, Port Boulevard and the deep water slip south of Bicentennial Park on the mainland side (see Figure 82).

15. <u>Lummus Island</u>. This island should be stabilized.

Public Access

16. <u>Fishing</u>. Additional shoreline access for fishing should be considered along the Venetian Causeway in conjunction with the bridge replacement program that is part of the 1985 Metro-Dade Transportation Improvement program. A fishing catwalk should be constructed on the north side of the eastern MacArthur Causeway Bridge.

17. <u>Bicentennial Park/FEC</u>. Water oriented uses such as the proposed maritime museum/aquarium complex should be given high priority in future planning for Bicentennial Park and the adjoining deep water slip and FEC property to the south. The existing auto racing and parking facilities should be phased out.

18. <u>Watson Island</u>. On Watson Island, marine/water oriented uses should be given the highest priority. These should include construction of marinas, facilities for large boats, retention of the swimming area on the north side, retention of the Miami Yacht and Outboard Clubs, retention of Chalk's Airline, improvement of the public boat ramps, provision of boat and sailboat rental facilities and provision of comfortable viewing areas. Riprap should be placed in areas along the north side of the island that are not vegetated with seagrasses or used for swimming or launching.

19. <u>Flagler Monument</u>. Flagler Monument Island should be stabilized, cleaned up, appropriately landscaped, and properly maintained.

20. <u>Street Ends</u>. The street ends at Lincoln Road and 14th Street on Miami Beach should be landscaped and developed with walks, lights, benches, trash receptacles and planting to provide public access to the shoreline in this area.

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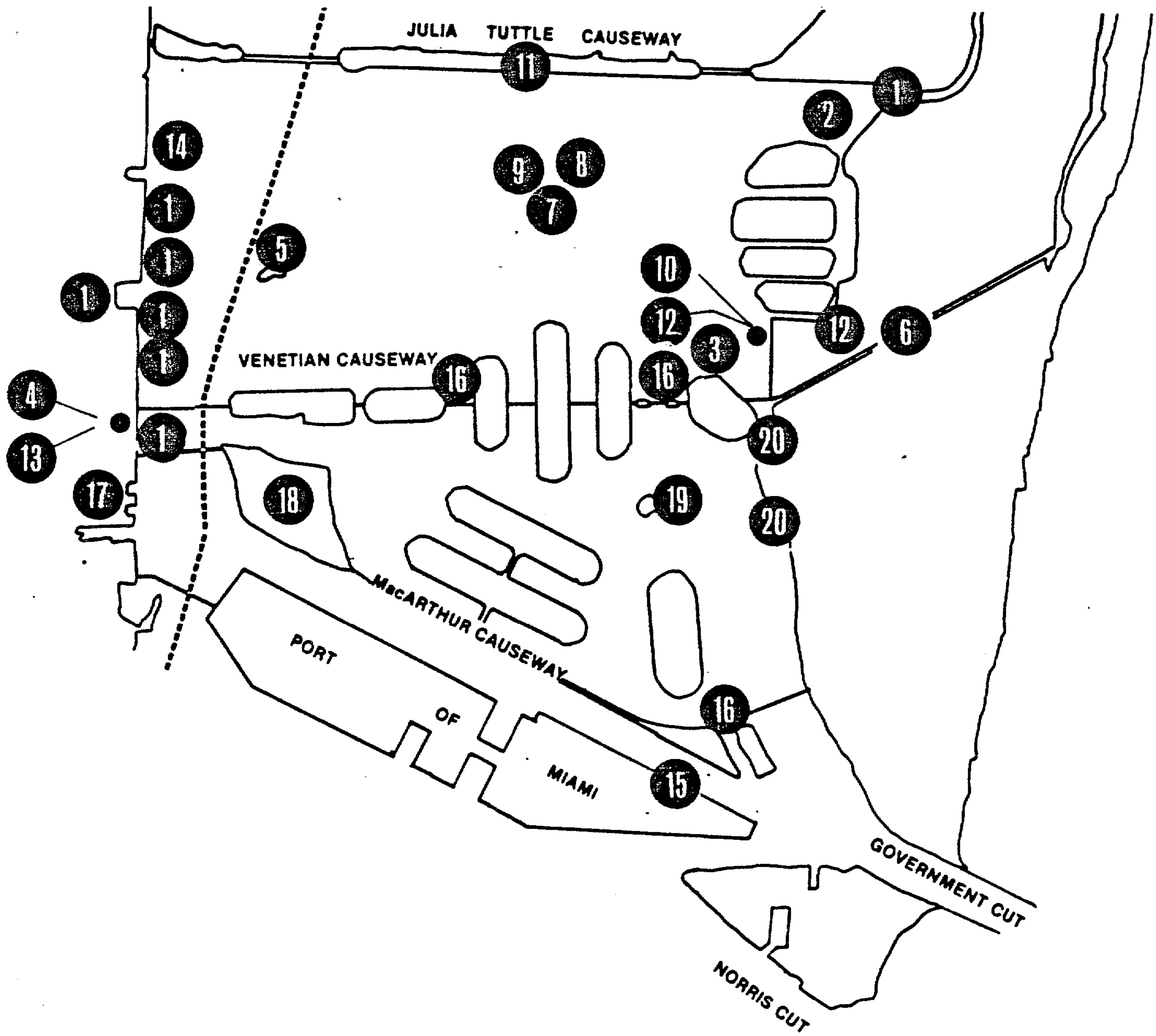


FIGURE 86
MANAGEMENT OPPORTUNITIES UNITS IV, V & VI

CHAPTER 7

UNIT VII

The Port of Miami to Rickenbacker Causeway

Introduction

This four and one-half square mile area is bordered on the north by the Port of Miami and Fisher Island; on the east by Norris Cut and Virginia Key; on the south by Virginia Key and the Rickenbacker Causeway and on the west by downtown Miami and the Brickell area from the Miami River south to the Rickenbacker Causeway. This Unit includes Miamarina, the Miami River which is discussed in Chapter 9, and the area within the Marine Stadium basin, but does not include the marina that was created on Fisher Island (See figure 87).

In contrast to Units IV and V which were largely developed prior to 1925, this area has been the focus of development activities since 1925. As a result of these changes and the recent expansion of the Port of Miami, this Unit is now bordered by more than 13 miles of shoreline, 44 percent of which are stabilized. Over five and one-half miles are vertically bulkheaded and two miles, mostly along the Government Cut Channel, are riprapped (see Figure 19).

Twenty-nine percent of this Unit has been dredged, the lowest percentage of dredged Bay bottom of the seven north Bay units (see Figure 34). The dredged areas are along the south side of the Port, the ICW, the borrow area north of the Rickenbacker Causeway and the Marine Stadium basin. The relatively low percentage of dredged area is reflected in the fact that the average water depth in this Unit is 5.6 feet (see Figure 15).

Unlike Units II-IV where tidal currents flow in a north to south direction through channels cut at the "corners" of the units, water flows into and through Unit VII from several locations and directions. On ebb tide water flows north through the relatively constricted openings in the Rickenbacker Causeway. For this reason van de Kreeke and Wang (1984) consider this Unit to be part of central Bay from a hydrological perspective.

The recent deepening of the channel on the south side of the Port and Government Cut has brought about an increased flow through Government Cut and a decreased flow through Norris Cut (van de Kreeke and Wang, 1984). As mentioned previously, residence time for this Unit is about one day and stagnation is not a problem except in the Marine Stadium basin.

As shown in Figure 88 the naturally deeper central portion of Unit VII was observed to be barren in 1925 and 1976. In-water observations in 1983 revealed that this area is covered with rock, rubble, sponges and patchy shoal grass. Where there is sediment present in the deeper areas it is commonly muddy with a very soft surface. There is sometimes a zone of flocculent material lying above the bottom and the water column is usually quite turbid (Wanless et al, 1984).

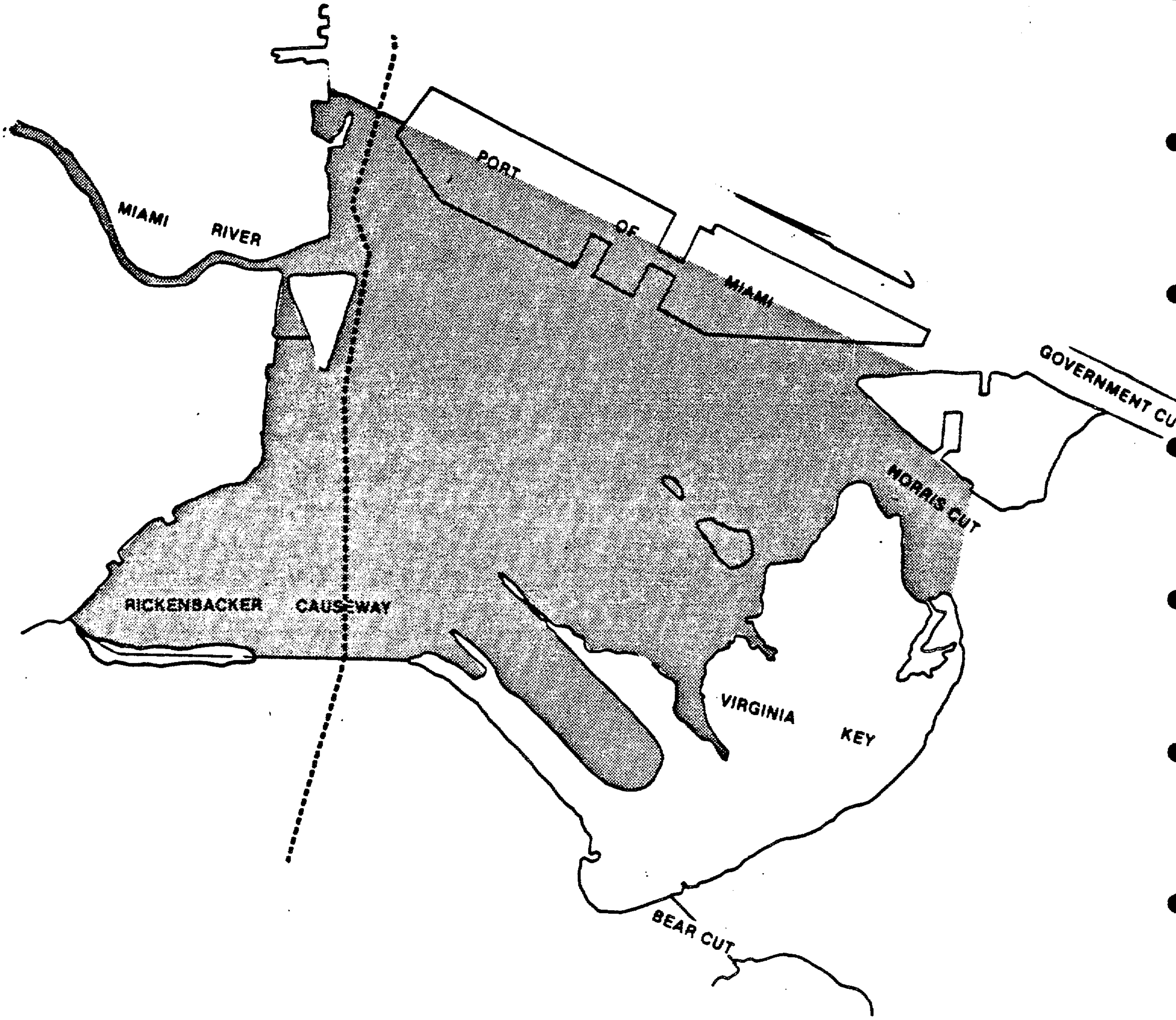


FIGURE 87

UNIT VII

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

AQUATIC PRESERVE MANAGEMENT AREA

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

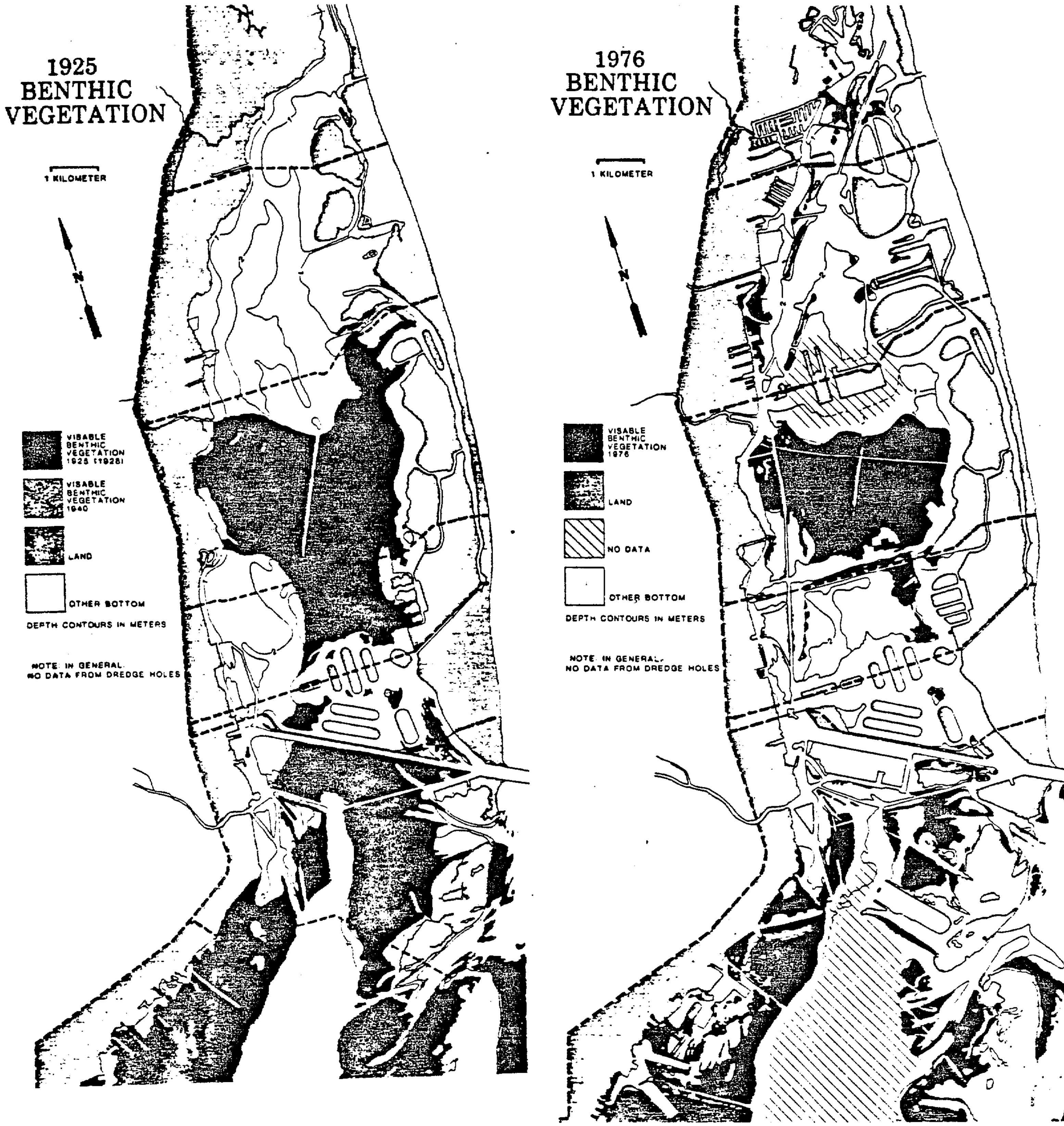


FIGURE 88

1925 & 1976 BENTHIC VEGETATION MAPS

SOURCE: HARLEM, 1979

Turbidity in this Unit comes from several sources including the Miami River; the unconsolidated fill margins along Rickenbacker Causeway, Dodge and Lummus Islands and the western side of Virginia Key; re-suspension of the flocculent material in the deeper central area and the growth of small organisms in the water column. The muddy shoal area west of Virginia Key is exposed to wave re-suspension during northwest winds (see Figure 27). During these events currents move the turbid waters out through Norris Cut or south through the opening in the Rickenbacker Causeway (Wanless et al, 1984).

Along the western shoreline of Virginia Key there has been a noticeable progression of mangrove seedlings and small trees in a westerly direction during the past decade.

Half of the Bay bottom in this Unit is vegetated, mostly in shoal grass or mixed seagrass communities (see Figure 34). During the two year benthic sampling program (Schroeder, 1984) the area southeast of Brickell Key and east of ICW was found to be the second best in the APMA in terms of different numbers of organisms and the third richest area in the entire Bay.

Just over a dozen stormwater outfalls greater than twelve inches in diameter discharge urban runoff from the mainland into the Preserve in this area (see figure 89). More importantly, however, is the overland runoff from the Port, Fisher Island, Brickell Key, Virginia Key and the Rickenbacker causeway that ends up in unit VII waters.

Historical Background

The area between the Port of Miami and the Rickenbacker Causeway has undergone massive changes since DeBrahm mapped the area in 1770 (Figure 90). DeBrahm's map shows one long land mass, which he named Narrow Island, stretching from Boca Ratones midway through the present land mass of Virginia Key. Norris Cut is not shown on DeBrahm's map and probably did not come into existence until the great South Florida Hurricane of 1835. On DeBrahm's map, Dartmouth Inlet (Bear Cut) is shown as being almost a mile wide and extending far to the north of its present alignment.

A map drawn in 1850 (see Figure 10) shows many familiar features, including Virginia Key, Norris and Bear cuts, the north-south channel at the center of the Unit and the natural channels that ran west and northwest from Cape Florida to within about one-half mile of the Miami River. This map also shows the shoal areas west of Virginia Key and to the west of the north-south mid-unit channel. There was little change in shoreline configuration between 1914 and 1924 (see Figures 76 and 69). The filling of Bayfront Park occurred in 1924-25 and as a result, a 12-16 foot borrow area was created just offshore of the Park. By 1928 the area south of the Miami River to Point View had been bulkheaded and Fisher Island, the tip of land severed from Miami Beach by the dredging of Government Cut, had been filled. The 1928 U.S. Coast and Geodetic Survey map also shows that Fisherman's Channel had been dredged to five feet in 1927 and that the channels running south from the Miami River and Fisherman's Channel had been dredged to 11 feet in 1920.

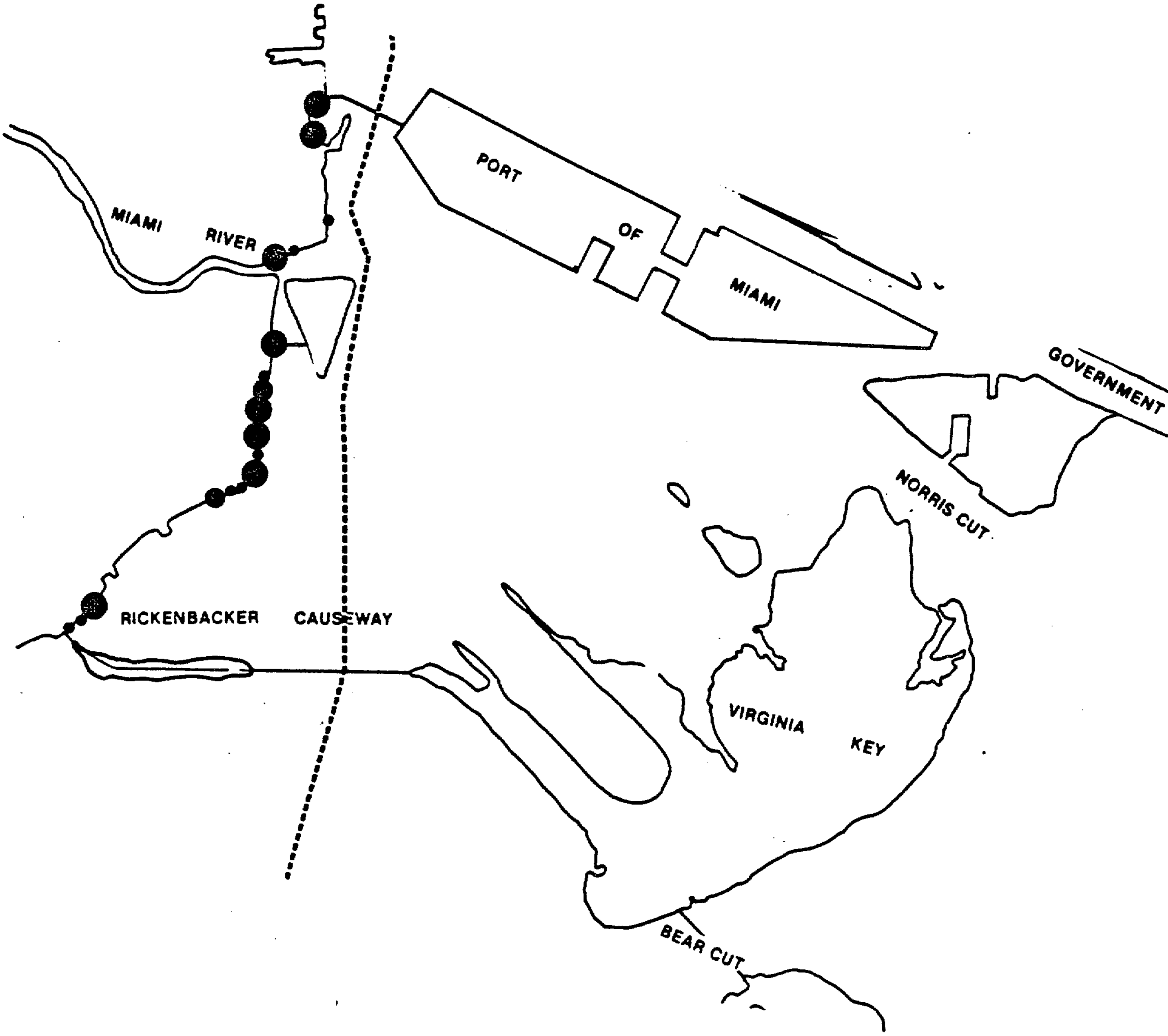
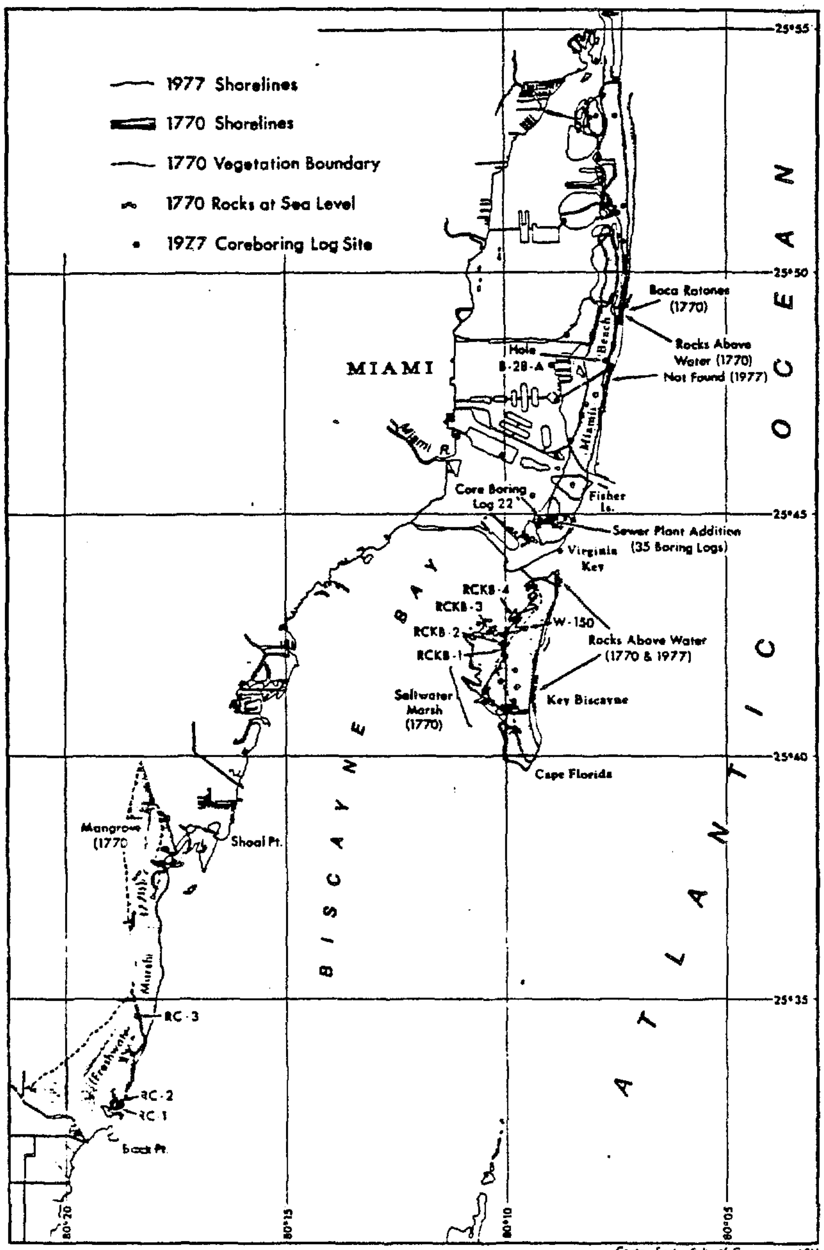


FIGURE 89

STORM WATER OUTFALLS

- ≥30″
- 24-30″
- 12-23″

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986



SHORELINES IN 1770, BASED ON DE BRAHM'S SURVEY, AS COMPARED TO THE PRESENT. BOCA RATONES INLET, OPEN BETWEEN ABOUT 1720 AND 1820 IS SHOWN. THIS PRODUCED A FLOOD TIDAL DELTA, LATER COVERED BY MANGROVES AND FINALLY DEVELOPED AS NORMANDY ISLES.

FIGURE 90

1770 MAP OF BISCAYNE BAY AREA

SOURCE: DeBRAHM IN CHARDON, 1978

Between 1928 and 1955 major changes took place in Unit VII (Figure 91). Burlingame Island was created just south of the Miami River off Brickell Point with the soil that was dredged from the River in the early 1930s. Burlingame Island was increased to its present size of 44 acres with fill derived from dredging the shipping channel. The island was bulkheaded and renamed Claughton Island prior to 1974. After World War II the Rickenbacker Causeway was filled and opened to traffic in 1947. By 1955, the Dodge Islands (Dodge and Lummus) are shown as sizable spoil islands south of the main shipping channel. The Marine Stadium was opened in 1962. Figure 49 shows the changes in developed land in this area from 1925 through 1976.

Changes Since 1974

No area of the APMA has experienced more development or redevelopment during the past decade than Unit VII. In addition to the massive changes at the Port of Miami, which have been discussed in the previous chapter, substantial changes have occurred along the downtown Bayfront, in the Brickell area, on Rickenbacker Causeway, and on Fisher Island.

In 1974 Miamarina was about 89 percent full, Bayfront Park was severely underutilized and Ball Point was being used as a parking lot. By 1985-86 the City of Miami had razed the old Bayfront Auditorium, Miamarina was temporarily closed, Bayside Specialty Center was under construction and major renovations were being made in Bayfront Park.

Located directly north of Bayfront Park, and south of Port Boulevard, Bayside Specialty Center will include 235,000 square feet of retail space. The Center's two story buildings which wrap around Miamarina have been designed to accommodate walkways and a central activities and vending plaza adjacent to the water. The development also includes four viewing piers which will allow people to enjoy the salt air and views of the Preserve from a perspective usually only available from the upper deck of pleasure boats. The Specialty Center, which represents an investment of over $100 million, is scheduled to open in the spring of 1987.

Construction at Bayfront Park is being funded through federal, state and local government grants and private donations totaling more than $17 million. The improvements include an outdoor amphitheater to accommodate 10,000 people, a subterranean service building and a maintenance area, a light tower for laser light shows, walkways, and rest room facilities.

In conjunction with this, the U.S. Army Corps of Engineers is stabilizing 1,800 linear feet of shoreline and building a Baywalk with courtesy piers adjacent to Miamarina and a pier at the end of Chopin Plaza. Following the demolition of the old public library building, the Corps will build a 60 foot wide promenade located on the axis of Flagler Street. This will create a critical pedestrian link between Biscayne Boulevard, Bayfront Park and the Baywalk. Future phases of construction will include a rock garden restaurant, a fountain within the Baywalk dedicated to Claude and Mildred Pepper, additional plaza spaces, a small outdoor amphitheater, fountain and subterranean service building in the south end of the park, and play sculptures.

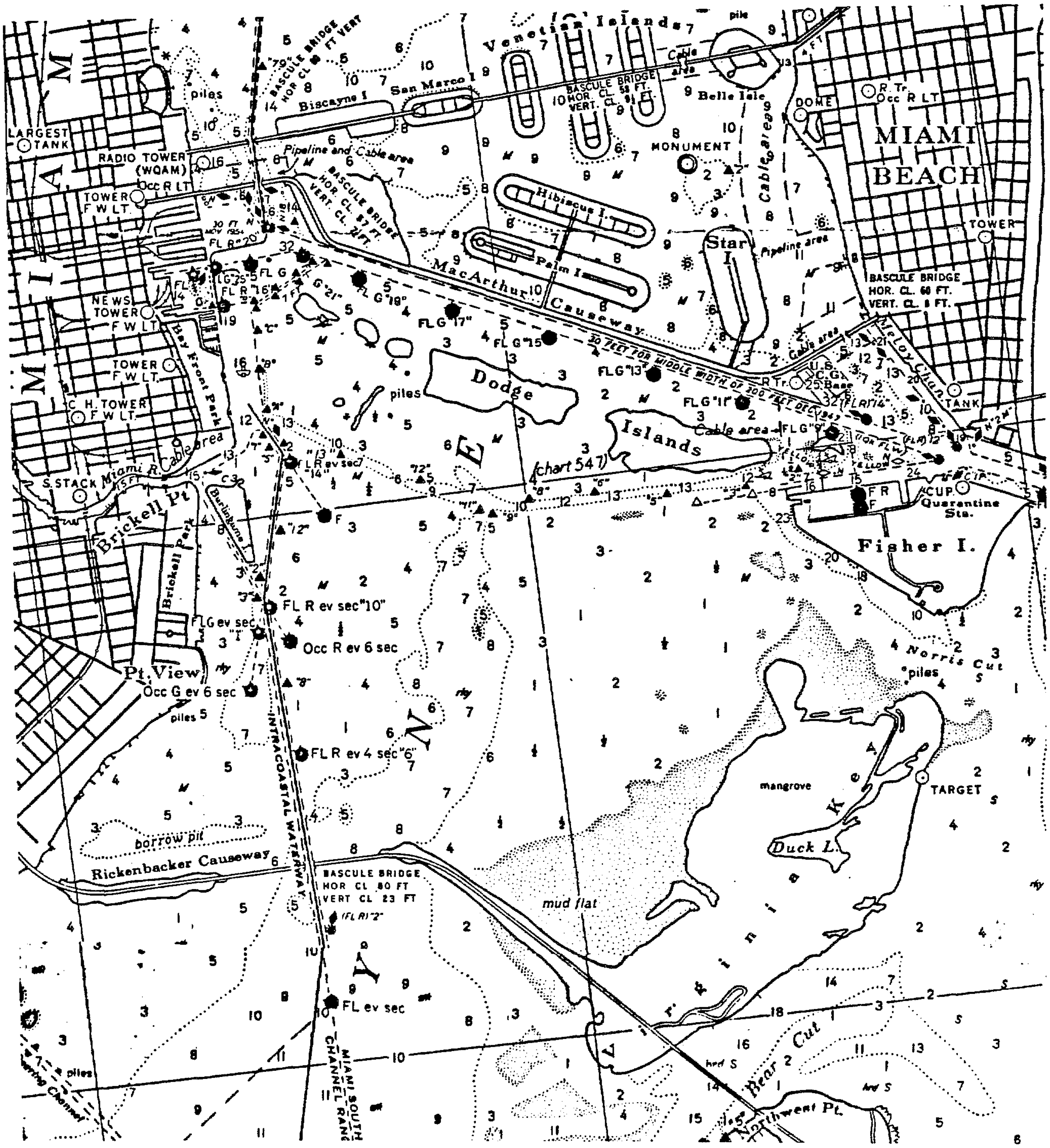


FIGURE 91

NAVIGATIONAL CHART OF BISCAYNE BAY AREA, 1955

SOURCE: U.S. COAST & GEODETIC SURVEY
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

The Bayfront Park Redevelopment Project will greatly enhance the public's use and appreciation of the Preserve. The quality and utility of the Preserve will also be improved by the placement of natural limestone riprap along the shoreline, and by providing space for fishing and transient dockage at the piers.

At the southern end of Bayfront Park, Miami Center, a mixed use office tower, hotel, retail and parking facility was completed in 1983 at a cost of $183 million (City News, May, 1986). This controversial development blocked Bay views and vistas and provided nothing in the way of amenities at the "Baywalk" that was left unfinished along the shoreline. Moreover, the riprap that was required to be placed adjacent to the bulkhead at this site has not been installed. The parcel of land between the Miami Center and the Old DuPont Plaza Building was not developed during the 1976-85 period.

To the south of the River and just offshore of the mainland, Brickell Key - Phase I, a 21 story residential tower with condominium units and office space was completed in 1982. A second 24 story building was on hold during 1985-86, but by early 1986 the Courvisier Center, a seven story office building, was under construction on the western side of the key. As part of the Phase I work, the island was riprapped for 1,700 feet along the north and eastern sides. Inspections of this area revealed healthy growths of algae, sponges and corals and significant numbers of reef fishes (Karafel, personal communication, 1984).

On the mainland, south of the River, the Brickell Point Holiday Inn was completed in 1981. This project included a Baywalk and 500 feet of riprap adjacent to the bulkhead. To the south, Lincoln Tower and the Sun Bank were constructed on Brickell Avenue, but no significant improvements were made along the Bay shoreline as a result of these projects.

At 80 South Bayshore Drive, the $6 million conversion of the former Four Ambassadors Hotel into a condominium facility was completed by 1982. There were plans to also expand the marina as part of this renovation but they had not materialized as of 1985-86 due to the inability to obtain a DNR submerged land lease.

To the south of the Four Ambassadors, the Brickell Bay Office Tower was completed in 1985 at a cost of $65 million, but no substantial improvements were made along the shoreline at this site. From this site south to Point View few notable changes in shoreline use were made during the 1974-85 period.

At Point View two high rise residential structures were constructed between 1974 and 1978. The City of Miami repaired the bulkhead at Point View in 1984, but no other shoreline improvements have been made to this area.

From point View south to Brickell Mar at 2201 South Bayshore Drive, four large condominium developments with associated private marinas were constructed during the 1974-85 period. Together these marinas have over 140 wet slips. From Brickell Mar south to the Rickenbacker Causeway, the high rise development was done prior to the enactment of the Biscayne Bay Aquatic Preserve Act in 1974.

At the southern end of this Unit, the new Rickenbacker Causeway Bridge was opened to traffic in 1985. The new 65 foot high bridge constructed over the ICW, was designed to improve public access, to mitigate for environmental damage and to improve Bay habitats. The ends of the old middle bridge, which is locally famous for fishing, were left in place as fishing piers and parts of the old bridge were dismantled and placed on the Bay bottom as an artificial reef. Natural limerock riprap boulders were placed water-ward of all bulkheads except in areas vegetated by seagrasses. A seagrass mitigation program included removing plugs of grasses which would otherwise have been destroyed by dredge or fill activities, and replanting them in barren areas in Unit IV.

Along the Causeway, the number of traffic lanes was increased and a bike path, separated from traffic by landscaping, was constructed. Parking areas and controlled access will help to control the flow of cars on and off the causeways and provide a safer area for recreational use. The Causeway will remain within the purview of the Metro-Dade County Public Works Department. Therefore parking will be free, dogs will still be allowed in the area, and uses along the shore will not be restricted.

On Virgina Key several changes occurred in the 1974-85 period. The Rusty Pelican Restaurant was expanded and then destroyed by fire. Marina Biscayne and the Key Marina, a rowing club facility, and Planet Ocean were constructed. The western end of the island was empounded and being filled in 1974 with material that was dredged from the shipping channel to the north. By 1985 much of this area had become revegetated.

Coastal Construction. As would be expected from the preceeding discussion, there have been a relatively large number of coastal construction permits applied for and issued in this area since 1980. In all, there were 33 permits issued for docks, pilings, seawall repair and replacement and the placement of riprap. These permitted works accounted for more than $4.5 million of work in this Unit.

UNIT VII - 1986

On the western downtown shore from the Port south to the Miami River, the shoreline appears to be dominated by tall buildings when viewed from the water. However, the buildings are located across Biscayne Boulevard which separates Bayfront Park and the Bayside/Miamarina area from the rest of downtown Miami. The Bay and shoreline are hidden from the ground level view throughout most of the downtown area. Only from the Metro-Mover and high-rise buildings does the waterfront become visually accessible from the downtown district. However, as discussed above, the opening of Bayside and improvements at Bayfront Park are expected to link the Port, Bayfront and downtown Miami areas.

The Brickell area from the Miami River to the Rickenbacker Causeway, includes two distinct districts; the intensively developing office district from the Miami River south to SE 14 Street; and the high-rise residential condominium area from SE 15 Street to the Rickenbacker Causeway.

When the area east of Brickell Avenue from the Miami River south to SE 12 Street is viewed from the water, it appears as a dense collection of high rise towers with different types of reflective surfaces. Except for the shoreline at the Brickell Point Holiday Inn which has a pleasantly landscaped shoreline walkway, the remaining shoreline in this part of the Brickell area is inaccessible and unseen by the general public. Only at the General Development Corporation headquarters building at 1111 South Bayshore Drive has the shoreline been treated with sensitivity and integrated into the building's landscaping and use.

Brickell Park, just south of the Holiday Inn at the Miami River, is a small, underutilized Bayfront park which could provide public access to the Bay shore for the growing numbers of office workers in this area, if redesigned. The City of Miami Parks Department has developed plans to extend the Bay-walk south from the Holiday Inn across the site.

From SE 12 Street, south to Point View, the parcels along the shoreline are vacant. This undeveloped area has enormous potential as a location immediately adjacent to the rapidly developing Brickell core where new development can be done in a manner to bring people to the shoreline.

Most of the structures along the Brickell Bayfront south of 14th Street bear little or no relationship to the water or shoreline, except from a perspective of height. However, unlike Miami Beach's "Condo Row," the position and design of the buildings on Brickell create a less obtrusive line of buildings when viewed from the water because they are generally situated with their bulk on an east/west axis. From the Brickell Avenue side, however, the Bay is totally hidden from view by the elevation of the land, as well as the vegetation and buildings. Some of the buildings are very colorful, and some historical sites included in the National Register remain scattered amongst high-rise buildings. However, in many instances non-water oriented facilities are located directly on the shore obscuring the water's edge even for those who reside in the buildings.

Public visual and physical access along this stretch of shoreline is almost completely nonexistent. If it were not for Pointe View, the area where South Bayshore Drive runs along the shore between SE 14 Street and SE 15th Street Road, there would be no way to see, or get near the Bay along the entire shoreline from Brickell Point to Rickenbacker Causeway. The City of Miami developed plans for a boardwalk to improve public access at Pointe View. However it was not built, because it would have shaded seagrasses.

<u>Rickenbacker Causeway.</u> Along the southern boundary of Unit VII the Rickenbacker Causeway links the mainland to Virginia Key and Key Biscayne. While this well traveled causeway was not originally intended to provide Bay access, it is heavily used for swimming, boating, windsurfing and hang gliding.

The construction of the new Rickenbacker Bridge has eliminated many of the conflicts that formerly existed between vehicular traffic going to or from Virginia Key and Key Biscayne and boat traffic going north and south on the ICW. However, this is still a relatively dangerous area because most of the boaters tend to head for the center span of the bridge, even though there is room for smaller boats to pass under the lower side spans.

Virginia Key. Because of foresight and planning, Virginia Key provides space for a number of water oriented activities and facilities, including the Rosenstiel School of Marine and Atmospheric Sciences, N.O.A.A. and the Southeast Fisheries Laboratory, Planet Ocean, the Marine Stadium, the Miami Seaquarium, Marina Biscayne and Key Marina. Most of these facilities are located on publicly owned land. In addition, a number of City or County operations, including a County regional sewage treatment facility and a large shoreline park, are located on this island.

The natural mangrove and shoreline communities which border the island and the mud flats on the western side of the Key provide valuable wildlife habitat. The water area is so shallow that boat access is severely limited in this area. There are two small islands which are fringed with mangroves. Because of the diversity of shore, wading and migrating birds that can be observed in this area, the Audubon Society has conducted birdwalks along the western shoreline of Virginia Key for many years.

The City of Miami has developed a master plan for Virginia Key which will guide future use of this valuable area. Along the western Bay shore of Virginia Key the City has proposed that the expanse of mangroves and a small hammock area become part of an environmental preserve. A nature study center, raised boardwalks and water trails, and an observation platform will be constructed if funds become available. North of the beach area is a small lagoon which is accessible from Norris Cut. Shrimp boats moor and derelict vessels are located in this lagoon which is believed to be a breeding area for Manatees. The City plans to seal off the lagoon to protect the manatees from power boats. Overall, the City's plans provide a reasonable range of uses and public access while at the same time recognizing the uniqueness of this area and the long term environmental opportunities it affords.

Fisher Island. Just south of Government Cut and east of the Port of Miami is Fisher Island. Prior to dredging of Government Cut, this island was the southern tip of Miami Beach. The northernmost shore is the site of the Belcher Oil Company petroleum depot and storage tanks and a University of Miami Marine Laboratory. Belcher tugs push two barges loaded with petroleum south to Turkey Point daily from this site. A large estate built by the millionaire W. V. Vanderbilt in 1936 on the south side of the island has been refurbished as a private club. The rest of the island is devoted to mid-rise, high-priced condominiums, tennis courts, a beach, two marinas, a plant nursery and open space. Ferry service from the south side of the MacArthur Causeway provides a transportation link to the rest of Miami.

In-Water Activities. Private marinas have been built in conjunction with residential developments along the western shoreline of Unit VII (Table 19 and Figure 92). Many of these marina facilities have been largely vacant for several years. Based on aerials taken in February 1986, there was an overall marina occupancy rate of 61 percent in Unit VII.

TABLE 19

Marinas With More Than Ten Slips In and Adjacent To
Unit VII - Excluding the Miami River

No.	Type	Facility	Wet Slips	Dry Racks
52.	Public	"Miamarina"	Closed in 1986	
53.	Condominium	801 Brickell Avenue	26	
54.	Condominium	"Fisher Island" Visitor Dock	Transient	
55.	Condominium	200 SE 15 Street Road	12	
56.	Condominium	1581 Brickell Avenue "Villa Regina"	43	
57.	Condominium	1901 Brickell Avenue "Brickell Place"	67	
58.	Condominium	2101-5 Brickell Avenue Brickell Bay	20	
59.	Condominium	2200 Brickell Avenue (approximately)	14	
60.	Commercial	Virginia Key "Marina Biscayne"	173	224
61.	Commercial	Virginia Key "Key Marina"	___	250
	TOTAL		355	494
		Adjacent to Unit VII		
	Private	Fisher Island Marina	88	

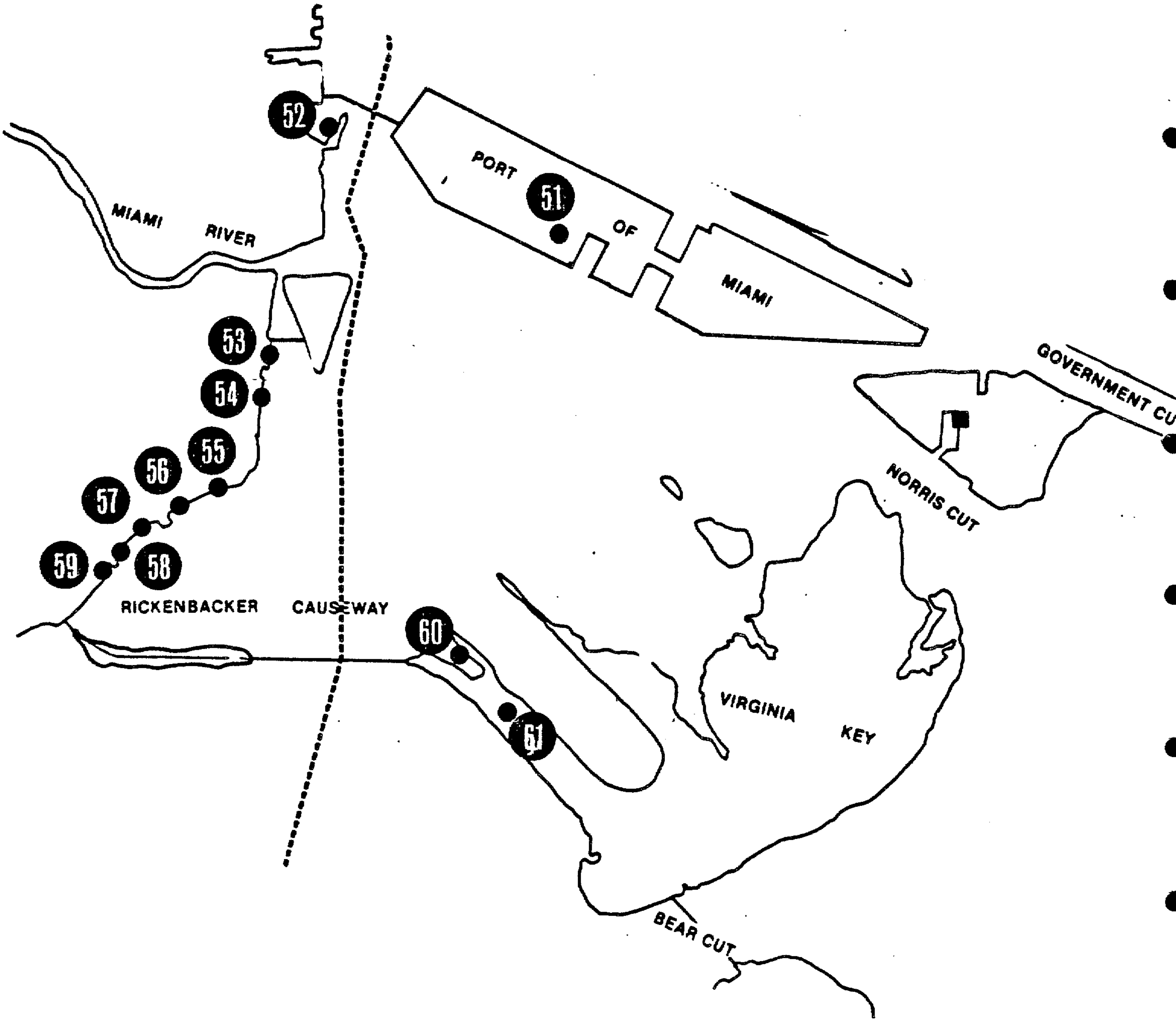


FIGURE 92

MARINA LOCATIONS

● WITHIN APMA

■ ADJACENT TO APMA

SOURCE: METRO-DADE PLANNING DEPARTMENT, 1986

Boating activities within Unit VII (see Figure 93) are almost exclusively limited to passing through the unit via navigational channels and activities around the Marine Stadium. The ICW provides the major north/south access route through the area. A large number of boats from the Miami River add to the boat traffic in this area. Because of boat wakes and the expanse of the western Bay shoreline that is vertically bulkheaded, wave energy builds, and the water becomes quite rough at times.

There is a shallow ledge just east of the ICW, making it difficult for most boat traffic to travel outside of the marked ICW channel. However, there is an unmarked deeper area (approximately 7 feet at mean high tide) which runs north/south from the Rickenbacker Causeway to the channel on the southern side of the Port of Miami. This is used primarily by persons who know the area well, and can navigate boats through unmarked waters.

While Government Cut provides the major access route to the Ocean for recreational as well as commercial vessels, shallow draft boats can gain access to the ocean through Norris Cut. Although portions of Norris Cut are deep, the area just outside of the Cut is extremely shallow, measuring only 2 feet at mean high water. Other in-water activities within Norris Cut include fishing and swimming from both boats and shore.

The area just north of Rickenbacker Causeway is used for several different activities. Just offshore of the westernmost causeway island, people swim, water ski and jet ski. People fish and shrimp from the old bridge spans. During a full moon, people can be found shrimping from both boats and from the old Causeway bridge in Unit VII.

The water area around Marine stadium, located on the north side of the Rickenbacker Causeway is not only used for power boat races, but also for concerts. Many boaters attend events by anchoring just offshore of the stadium. Water skiers, windsurfers and jet skiers compete for space in this small, stagnant, protected area. Key Marina, just west of the Marine Stadium, has dry boat storage with a boat ramp and hoist, and jet ski rentals. Windsurfing rentals are also available in this area.

Submerged Lands. Limited available data on submerged land conveyances in Unit VII indicate that a majority of the 4.4. square miles of Bay bottom have been conveyed by the State to other governmental and private entities. Only the small areas surrounding Brickell Key (Claughton Island), the Brickell area shoreline, Fisher Island, and the southwestern tip of Miami Beach remain in State Ownership (Figure 94).

Use of submerged lands within Unit VII is not only governed by sovereignty ownership and Federal, State and County coastal construction regulations, but also by the Cities of Miami and Miami Beach jurisdiction over this unit. These municipalities can control activities and construction on the shoreline and within the water areas that are under their respective jurisdictions.

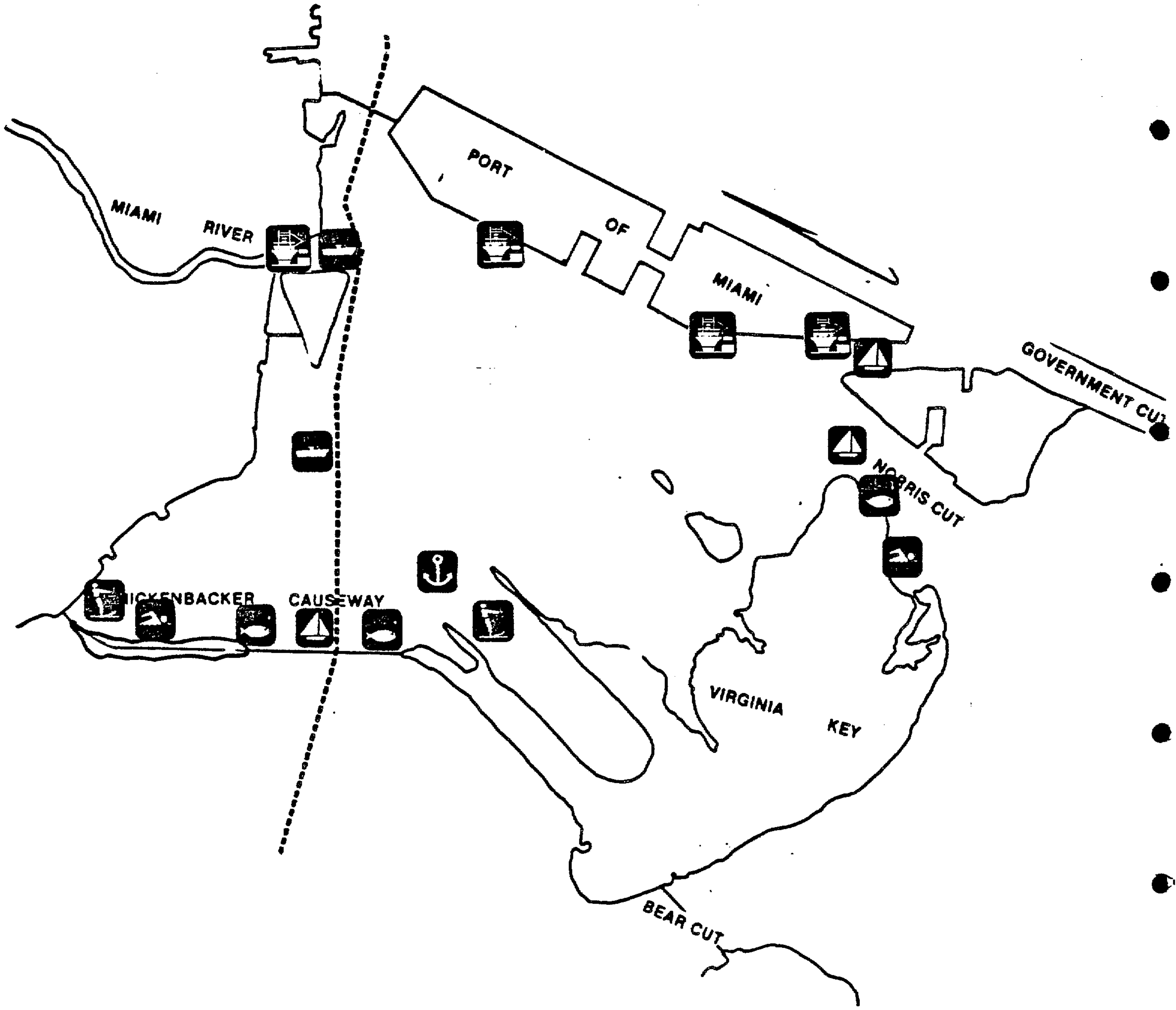


FIGURE 93

IN-WATER ACTIVITIES

SOURCE: METRO-DADE PLANNING DEPT., 1986

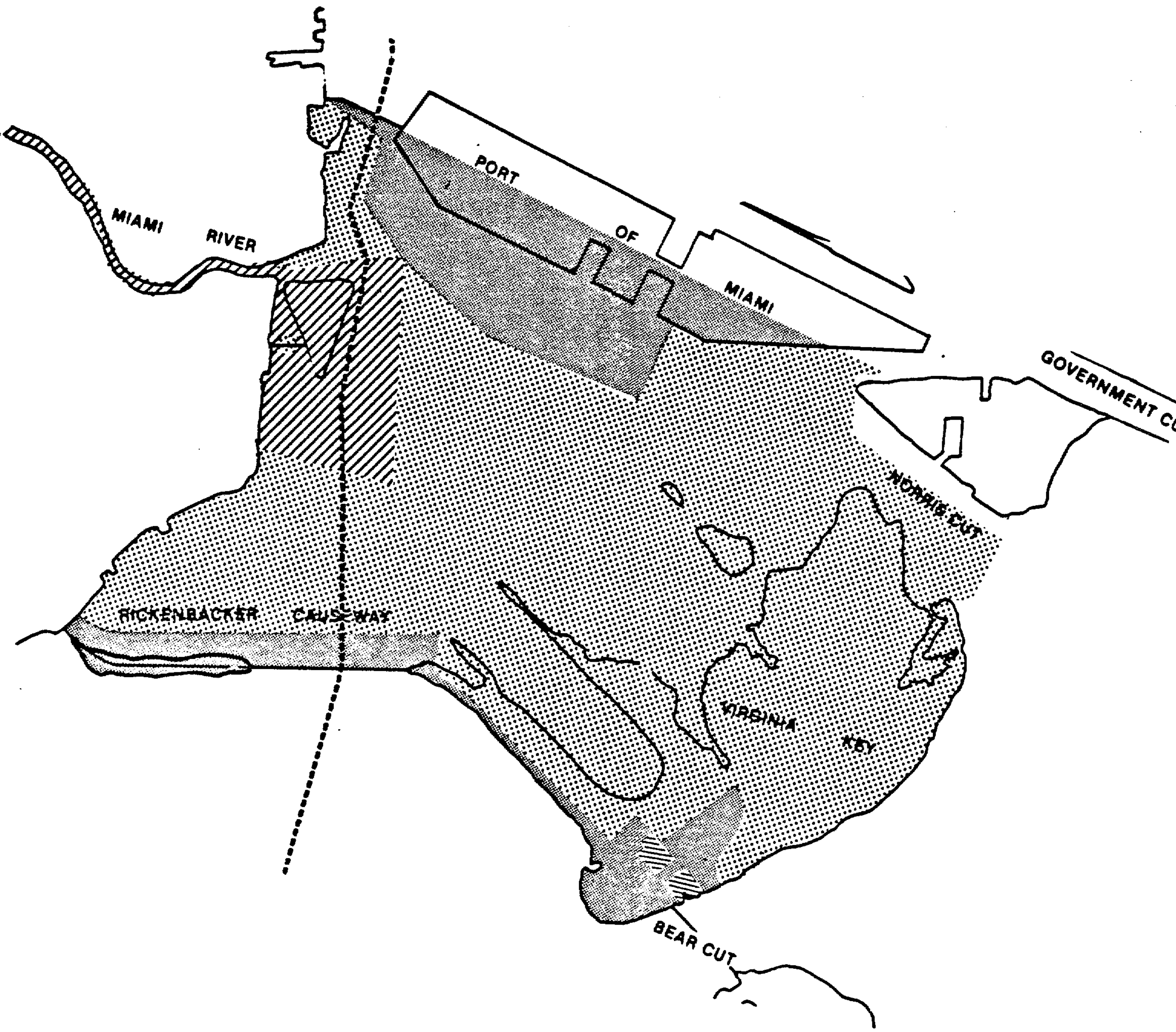


FIGURE 94

LAND OWNERSHIP PATTERNS

- FEDERAL
- STATE
- COUNTY
- CITY OF MIAMI
- CITY OF MIAMI BEACH
- SPOIL ISLANDS & SPOIL ISLAND EASEMENTS

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCE: CITY OF MIAMI BEACH, 1985
CITY OF MIAMI PUBLIC WORKS DEPT., 1969
METRO-DADE PUBLIC WORKS DEPT., 1977 & 1981
METRO-DADE PARK & RECREATION DEPT., 1986
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1977

This unit is underlain with cables, pipes, channels, pilings and wrecks. The cable and pipeline areas crisscross through the central portion of this basin (see Figure 43). A number of visible and submerged wrecks lie along the shallow ledges in this area (see Figure 44). An artificial reef under the old Rickenbacker Causeway bridge is also located in Unit VII (see Figure 44). A spoil area remains designated along the north-western mangrove shoreline of Virginia Key (see Figure 41). The ICW provides clearly marked navigable waters through Unit VII in a north/south direction and Fisherman's Channel along the southern side of the port provided deep waters in an east/west direction, and access to Government Cut and the ocean.

UNIT VII

MANAGEMENT OPPORTUNITIES

The location of specific management opportunities for this Unit are listed below and shown on Figure 95. These suggestions for improving this area are grouped under the following general headings: water quality, resource conservation, public access and public safety to correspond to the general recommendations at the end of Chapter 1.

Water Quality

1. Storm Water Outfalls. From the standpoint of size alone, the outfalls at Miamarina, Port Boulevard, SE 12 Street and SE 25 Road should be eliminated or redesigned to minimize the impact of the first inch of rainfall on the preserve (see Figure 89).

2. Riprap. The shoreline at Miami Center and the southern end of Brickell Key should be riprapped.

Resource Conservation

3. Virginia Key. Protection of the mangroves, shore and wading bird habitats and eagle nesting sites should be given high priority. Any additional sewage pipelines from the mainland to Virginia Key should be extended through already disturbed Bay bottom areas. Boats should be kept out of the lagoon on the northern end of Virginia Key to protect the manatees.

Public Access

4. Street Ends. Public access to the Preserve should be improved at the street ends at SE 12 Street and SE 25 Road.

5. Point View. A boardwalk/fishing pier should be constructed at Point View.

6. SE 12 Street to Point View. Development in this area should promote views of and public access to the water. A public shoreline walkway should be constructed to link the street end at SE 12 Street to the shoreline area in Point View.

Public Safety

7. Channel Marking. The unmarked channel from the south side of the Port to Rickenbacker Causeway should be marked so that it can be used as an alternative to the heavily used ICW.

8. Rickenbacker Bridge. The FDNR should assess the feasibility of making the spans under the new Rickenbacker Bridge "one way" to spread out the boat traffic that tends to use only the center span.

9. Jet Skis. The use of jet skis should be restricted to the north side of the Rickenbacker Causeway.

10. Rickenbacker Causeway. Four wheel drive vehicles should be limited to access roads and parking areas; and off the road vehicles should be prohibited on the beach.

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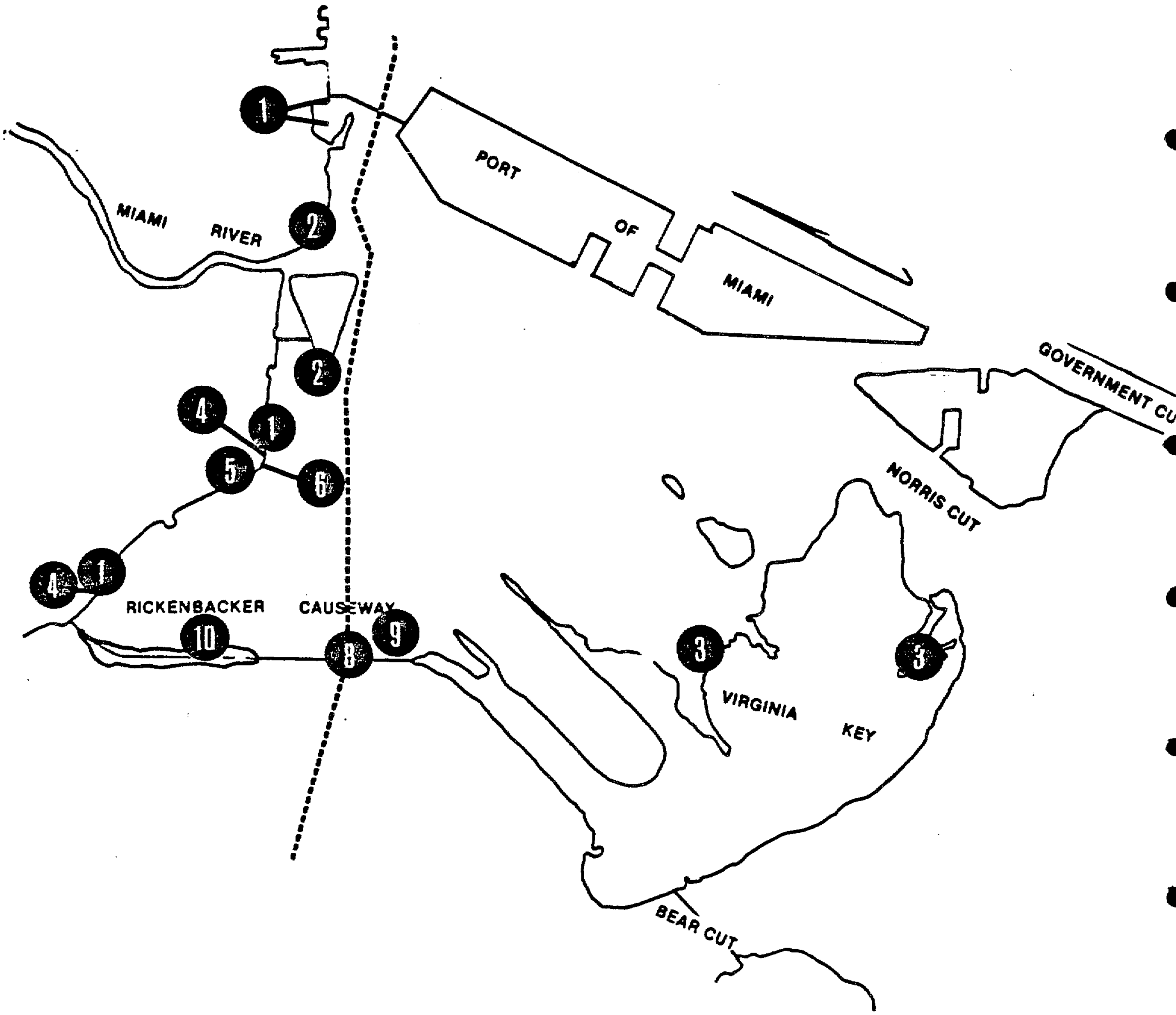


FIGURE 95
MANAGEMENT OPPORTUNITIES UNIT VII

CHAPTER 8

UNIT VIII

The Rickenbacker Causeway to Biscayne National Park

Introduction

The Unit VIII shoreline area consists of the mainland shore from the Rickenbacker Causeway south to the C-100 canal; the entire western shore of Key Biscayne; the southernmost shoreline of Virginia Key and the Rickenbacker Causeway spoil islands; and the various spoil and natural islands within the APMA boundary (Figure 96). This area is referred to as the Central Preserve Management Area (CPMA) in this document.

The southern boundary of the APMA and Unit VIII (CPMA) cuts through central Biscayne Bay. This line delineates Biscayne National Park's northernmost boundary and the area of federal jurisdiction within the Bay. It is important to note that this is only a jurisdictional line and does not signify physical changes within the Bay.

The open water area of Unit VIII consists of 44.7 square miles. Here the Bay is at its maximum width of 10 miles and its maximum natural depths of 13 feet.

Almost one-half of Key Biscayne's 10 linear miles of Bay shoreline is vertically bulkheaded. Four linear miles are mangrove and less than one mile is riprapped (see Figure 20). The small mangrove islands off of Key Biscayne account for one additional mile of shoreline. The two miles of shoreline along Virginia Key consist of 81 percent unconsolidated and 15 percent vertical bulkheads. The Rickenbacker Causeway's one mile of shoreline consists of 96 percent unconsolidated and 4 percent riprap.

There are approximately 28 linear miles of mainland shoreline between the Rickenbacker Causeway and the C-100 canal. Ten miles are vertically bulkheaded, five miles are unconsolidated (including the Dinner Key area spoil Islands), 12 miles are mangrove (including Chicken Key and other small islands in the Kings Bay area), and less than a mile is riprapped. As expected, the vertical and unconsolidated shoreline areas are located predominantly in the Coconut Grove and Coral Gables areas, while the mangrove shoreline is located along and around the Chapman Field and Matheson Hammock areas.

Water quality data are collected on a monthly basis and analyzed by Dade County DERM for eight stations in Unit VIII (see figure 21). Generally, water quality in the central Bay area is good to excellent. However, reduced water quality is present at the mouth of the Snapper Creek Canal and near the Rickenbacker Causeway (DERM, 1984).

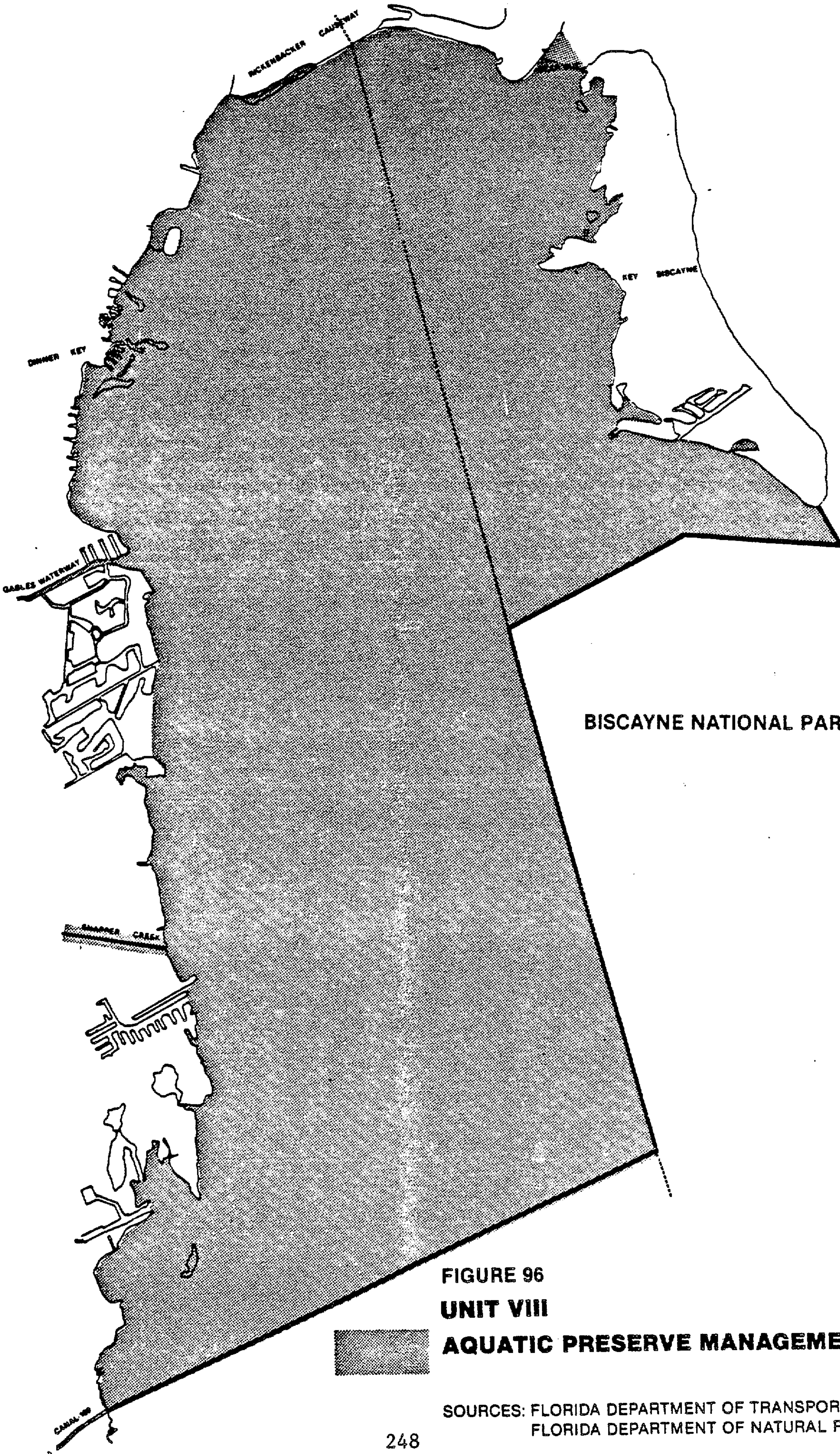


FIGURE 96

UNIT VIII

AQUATIC PRESERVE MANAGEMENT AREA

SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION &
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1984

Circulation within Unit VIII is influenced by tidal flow entering through Bear Cut and across the Safety Valve network of shoals and channels located south of Cape Florida. More water enters the Central Preserve Management Area during an incoming tide than goes out on an outgoing tide. The net water movement proceeds in a northerly direction through the Rickenbacker Causeway openings (Swakon, 1977).

As in north Bay, there are stronger current velocities (30-60 centimeters per second) close to the Ocean inlets/outlets than the interior portions of central Bay where the velocities are on the order of 5-30 centimeters per second (Swakon, 1977). Wind also influences water circulation and velocities in the CPMA. Residence time can be cut in half under certain wind conditions (Swakon, personal communication, 1985).

Overall, the Bay south of the Rickenbacker Causeway has much lower prevailing turbidity levels than northern Biscayne Bay. Resuspension of carbonate particles is the predominant form of turbidity in central Bay, except in the naturally deep central area of Unit VIII where fine flocculent materials are resuspended by tidal currents, and near the mouths of mainland canals where diatoms and other organics predominate. Wanless et al, (1984) also found that the areas just south of Rickenbacker and west of Southwest Point on Key Biscayne had persistently higher turbidity levels than the rest of the central Bay area. Generally, the deeper seagrass covered areas have higher turbidity levels than shallower seagrass areas and areas with a thin veneer of sand over the limestone bedrock (Wanless et al, 1984).

Winter storms create turbid conditions in Unit VIII by resuspending materials from the flanks of natural and dredged channels. Northeasterly winds (see Figure 26) resuspend the fine materials that are produced in the rocky bottoms along the southwest portion of the area, and also cause turbid water to flow into the Bay across the Safety Valve (Wanless et al, 1984).

Another persistent source of turbidity in central Biscayne Bay is the Belcher barge. A tug pushing two large, flat barges loaded with fuel oil crosses the central Bay area along the ICW on its twice-daily trips from its Fisher Island terminal to the Turkey Point Power plant. Extensive turbidity plumes appear in the wake of this craft.

Of the 44.7 square miles of Bay bottom area in Unit VIII, almost one quarter is barren. Unlike the other APMA units where the majority of barren bottoms were dredged, only 25 percent of the barren areas in Unit VIII were dredged (DERM, 1983). This Unit has a much smaller percentage of dredged bottom areas than any other unit in the APMA.

Seventy-two percent of the total bottom area is covered by seagrasses and algae which baffle, filter and trap suspended and resuspended sediments. Hard bottoms communities consisting of molluscs, soft corals, coral and sponges, cover four percent of the Unit VIII bottom (see Figure 31).

As discussed in Chapter 1, the area parallel to the mainland shore consists of a rocky bottom with both exposed limestone, and limestone with a very thin veneer of sediment. Normally, these areas are unstable and do not effectively support seagrass communities. However, seagrasses have colonized these rocky bottom substrates during the past 20 years since the last hurricane. It is expected that these grasses will not survive the next hurricane, but the seagrasses that have become established in depressions in the lime-rock where there are thicker sediment accumulations are expected to survive (Wanless et al, 1984).

In addition to the extensive benthic communities within Unit VIII, the CPMA is bordered of hundreds of acres of mangrove shoreline (figure 97). These fringe forests have a critical influence on water clarity and natural resources in the central Bay area (Wanless et al, 1984). Murky tidal waters are filtered by the sponges, molluscs and barnacles that cling to the mangrove roots and trunks below the high water line. In addition to these filtering organisms, the mangrove roots themselves slow water flow enough to allow silt, nutrients and other suspended particles to settle out of the water column.

Historical Background

Some of the earliest descriptions of central Biscayne Bay and its shoreline were done by two British surveyors, DeBrahm and Romans, in the 1760's and 1770's (Figure 98). According to Chardon (1975), the following describes the Unit VIII mainland shore:

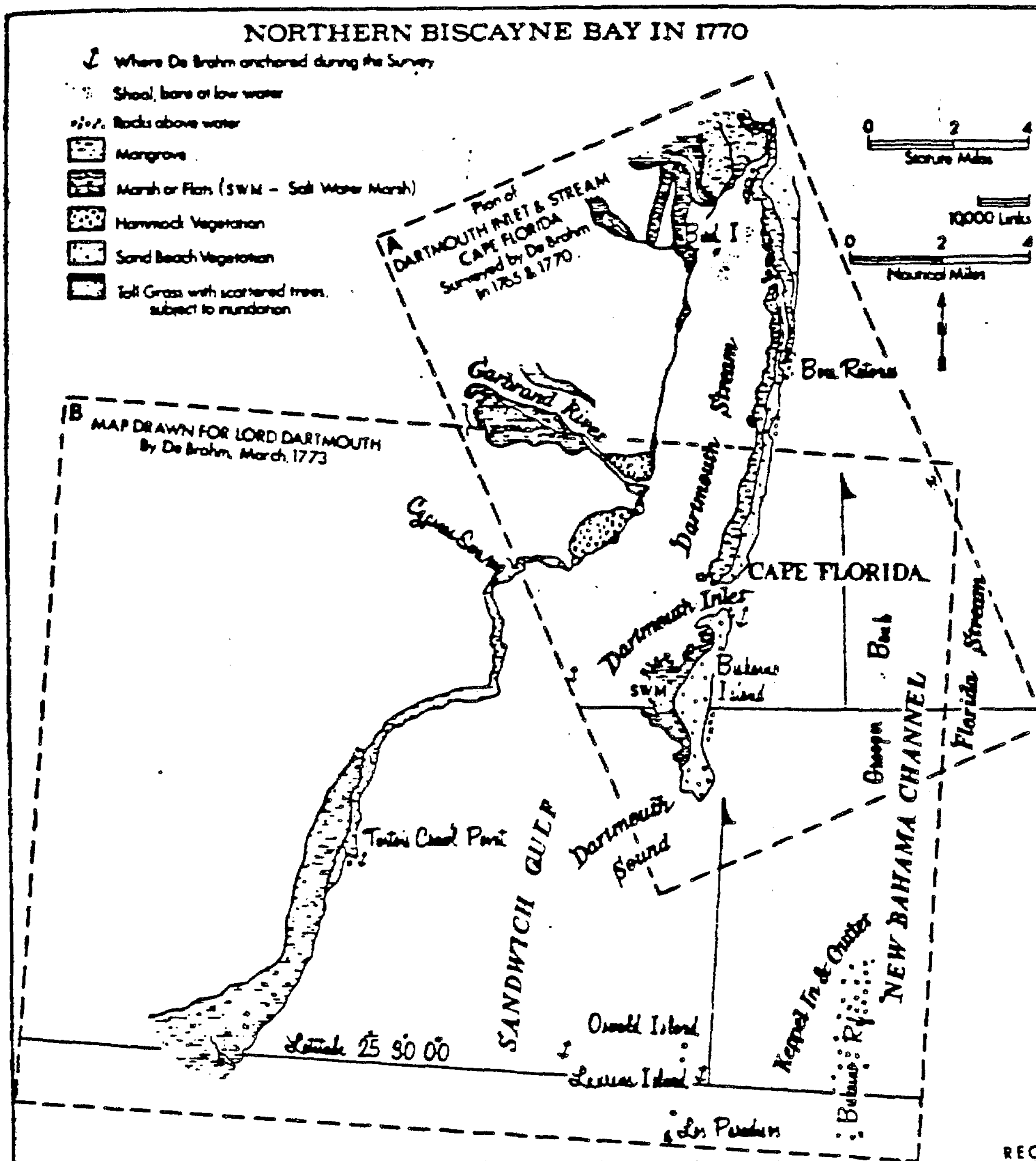
> "...Except for a small, low tidal marsh, indicated by DeBrahm (Figure 1) at about the place where today's Ricken-backer Causeway leaves the mainland for Virginia Key, a "rocky bluff" extended right along the shore from Point View to about a mile northeast of present Dinner Key. From there both men clearly show the bluff running a little distance inland from the water's edge, with a low inter-tidal strip between. At the northwestern end of what appears to be the bight on which Coconut Grove is present-ly located, DeBrahm marks the existence of a cypress swamp... From there, following the shore to a short dis-tance south of his Turtois Crawl Point, DeBrahm shows a narrow strip of mangrove behind the northern part of which apparently was higher ground. Romans, on his map indicates a "buttonwood swamp and hammock" and,.. a higher "pine barren" area inland. Behind the southern portion of the mangrove strip in this area, DeBrahm portrays a freshwater marsh, which displaces the mangrove entirely further south, and borders the Bay for some six miles south of present Cutler." (page 61)

Key Biscayne (Biskaino Island) was described by DeBrahm in 1770 (in Chardon, 1975) as an island with a Bayshore that consisted of a large saltwater marsh. According to Chardon (1975), this extended

FIGURE 97

MANGROVES OF THE CENTRAL PRESERVE MANAGEMENT ARE

SOURCE: METRO-DADE PLANNING DEPT., 1986



Carto Sect., Sch of Geosci LSU

SOURCES: INSET A FROM LIBRARY OF CONGRESS COPY OF MAP IN BRITISH MUSEUM, *KING'S MS 211*, FOL. 83 (11), AND ANOTHER ORIGINAL IN THE HOUGHTON LIBRARY, HARVARD UNIVERSITY. INSET B FROM *DARTMOUTH MS.* D(W)1778/II/654, STAFFORD COUNTY RECORD OFFICE, STAFFORD, ENGLAND.

FIGURE 98

NORTHERN BISCAYNE BAY IN 1770

further into the Bay than the present mangrove shoreline. On De-Brahm's 1770 map, however, Cape Florida was incorrectly located north of Bear Cut (Dartmouth Inlet).

Although small permanent settlements were known to have existed along the Bay as early as 2000 BC (Carr, personal communication, 1986), it was not until the 1800's that both White and Seminole populations began to settle the Biscayne Bay area. In 1825 the Cape Florida Lighthouse was constructed to warn mariners of the dangerous reefs offshore. Due to conflicts between the Whites and Indians, military bases were established, including Fort Bankhead (later renamed Fort Russell) on Key Biscayne in 1838. Through the 1870's there were no overland routes into south Florida and even boat access into central Biscayne Bay was limited to shallow draft vessels (Parks, 1977). According to Parks (1977), through the 1870's as disturbed military and agricultural areas were abandoned, the tropical vegetation quickly covered the traces of man.

The decade prior to the arrival of Flagler's railroad in 1896 was coined the "Era of the Bay" by Parks (1977). During this time the Coconut Grove community formed along the Bayfront, and the town of Cutler was a thriving community at the location of the Deering Estate. Freshwater springs abounded along the coastal ridge (Silver-bluff) and within the Bay. According to Munroe (1930), with the arrival of Flagler's railroad, the "simple and genuine life passed into a memory." The days of wilderness and pioneers were gone.

Drainage of the southeastern Everglades began in 1903. The Snapper Creek Canal and the Coral Gables Waterway were dredged between 1912 and 1913 (Harlem, 1979). Richeson Love's Map of the Central Bay area dated 1914 (Figure 99), shows Cocoplum (Tahiti) Beach just south of the present day Coral Gables Waterway. The area around Coconut Grove is shown as developed but the shoreline from Coral Gables south to Cutler is lined with mangroves much as it is today. The western shoreline of Key Biscayne from Northwest Point almost to the tip of Cape Florida is also lined with mangroves in 1914.

The destruction of the majority of these mangrove forests can be traced to dredging and filling, lowering of the water table and other human activities. There is also evidence that storms, hurricanes and perhaps changes in currents also eroded the mangrove shoreline (Teas, 1974 and Teas et al, 1976).

During the boom years of the early 1920's the spoil bank that would become Fair Isle (Grove Isle) was created when an "L" shaped canal and channel were dredged. In 1924 a wooden bulkhead was constructed around this spoil bank and the area was filled to a 2 foot elevation (Voss, 1974).

The U.S. Navigation charts surveyed in 1929 and printed in June 1931, show several changes that occurred in the central Bay area by 1929 (figure 100). There are channels shown leading from the naturally deep central Bay area to Dinner Key and Viscaya along the Coconut Grove shoreline there are canals and inlets at several Bayfront parcels.

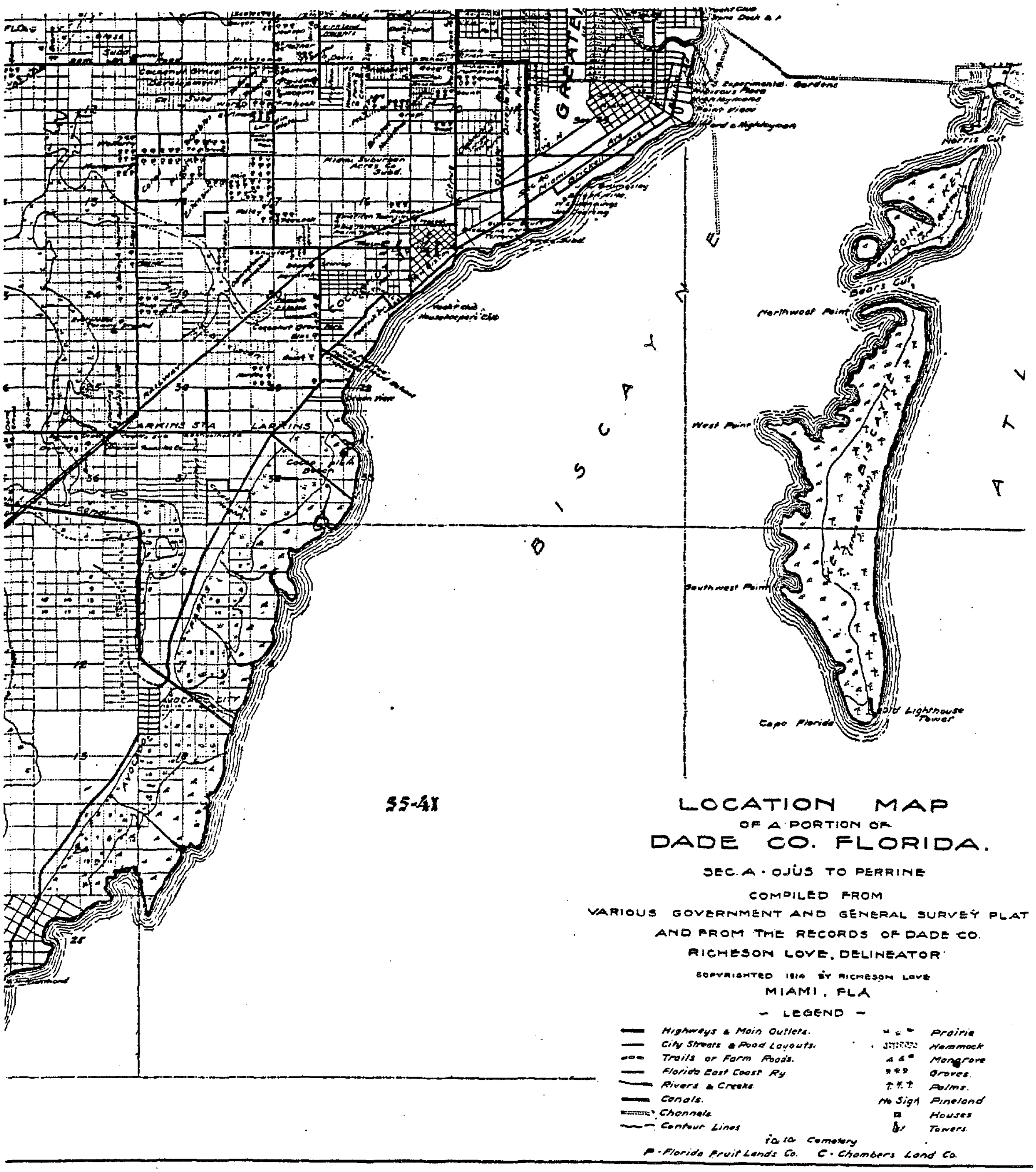


FIGURE 99

LOCATION MAP OF A PORTION OF DADE COUNTY, FLORIDA 1914

SOURCE: RICHESON LOVE, DELINEATOR
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

FIGURE 100

NAVIGATIONAL CHART OF BISCAYNE BAY AREA, 1931

SOURCE: U.S. COAST & GEODETIC SURVEY
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

By 1925 the Dinner Key bight area had been filled. The Coral Gables Waterway appears in its present form. South of this Waterway there is a thin band of mangroves with a wider band of freshwater marsh landward. The freshwater marshland ends at the present day Kings Bay Yacht Club location, but a very thin band of mangroves continues southward along the shore south of Cutler. On the western shore of Key Biscayne, Northwest Point is still lined with mangroves, but the area around Southwest Point, had already been reconfigured.

According to Teas et al, (1976), in 1922 the area immediately south of the Coral Gables Waterway consisted of a 325-650 foot wide band of red and black mangroves. To the west there was a freshwater marsh located between the coastal ridge and fields along the uplands. Photographs taken about this time indicate that the hardwood forest was cleared to develop a beach (referred to as either Cocoplum or Tahiti Beach on area maps).

Harlem's (1979) maps for 1925 and 1976 depict the shoreline changes for most of Unit VIII (see Figure 49). Harlem's dredged bottom maps for 1925 and 1976 (Figure 101) clearly outline the extent of dredging for most of Unit VIII. Harlem (1979) found that the mainland shore from Rickenbacker Causeway to Chapman Field had doubled in length since 1887, due to the "...complexity of canals, small spoil islands, filled bay front and the construction of the Rickenbacker Causeway..."

According to Harlem (1979), there was also a substantial increase in turbidity in the central area of Unit VIII from 1925 to 1976. Aerial photographs taken in 1940 show clear waters but aerial photos taken in 1970 and 1973, show this area as totally obscured by turbidity. Harlem (1979) attributes this change to the increased amount of spoil shoreline, dredging, urban runoff and an increase in the number of marinas and boats.

Changes since 1974

Since the passage of the Biscayne Bay Aquatic Preserve Act in 1974, the overall characteristics of the central Bay shoreline have generally remained the same. There have however, been a substantial number of individual projects within Unit VIII. A number of changes have occurred at Bill Baggs Cape Florida State Recreational Area. In the late 1970's a portion of the Park's concrete seawall was replaced, and riprap was added. Riprap and mangrove planting was also done in the "No Name" harbor, but due to vandalism few of the mangroves remain. Other park improvements include expansion of picnic areas, expansion and resurfacing of parking areas, and thinning of the Casuarinas along the seawalls. In 1978 the lighthouse beacon was relit for the first time since 1878. It is now maintained by the Coast Guard and relit each night to serve as a navigational guide.

At Crandon Park Marina, the wet slips were expanded from 5 docks with 125 slips to eight new, longer docks with 222 slips. The boat ramps were improved and eight piers were constructed at the ramps to assist boaters and to allow more boats to be put in or out at any given

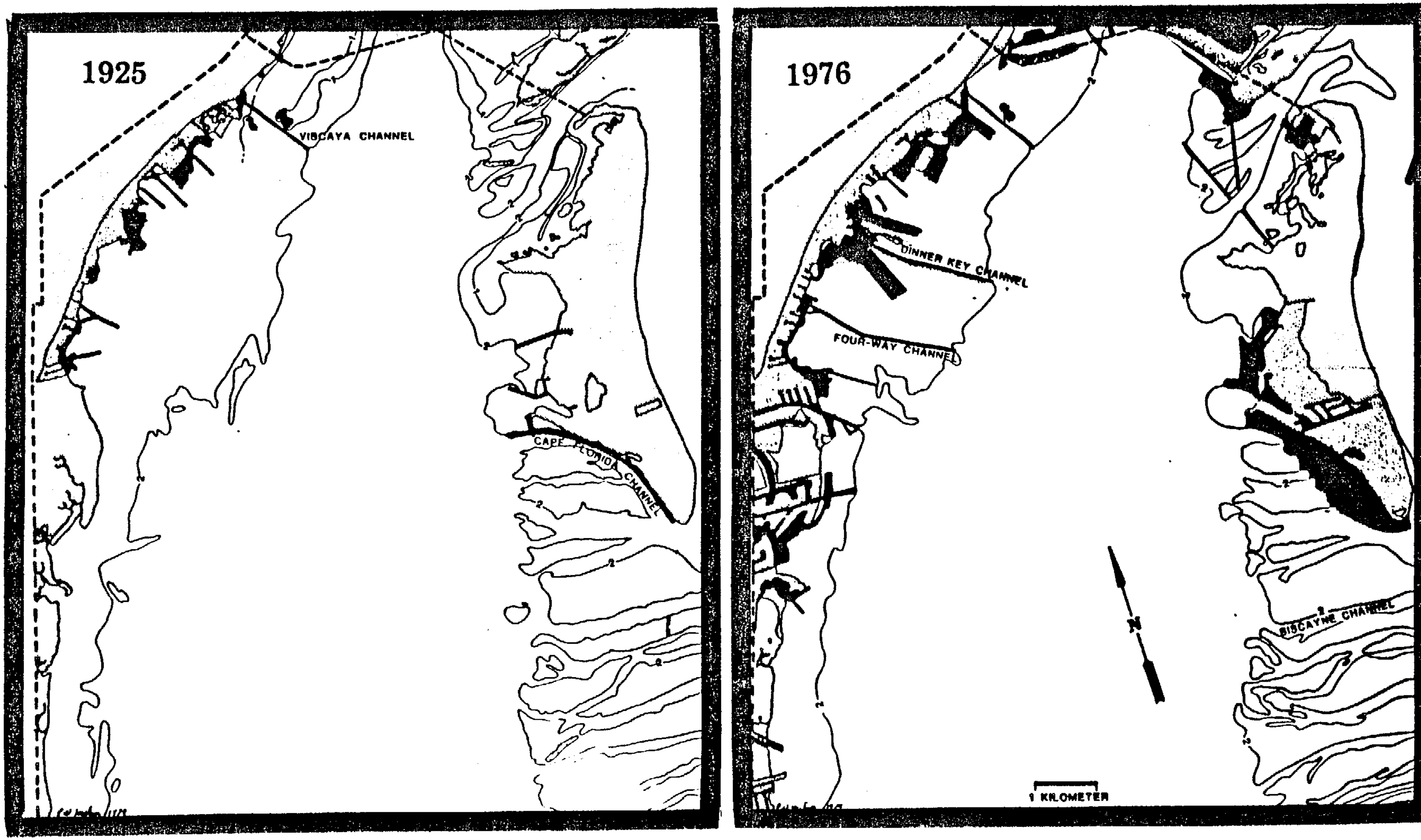


FIGURE 101

1925 & 1976 DREDGED BOTTOM

SOURCE: HARLEM, 1979

time. The small building housing a snack bar was expanded into a currently thriving waterfront/outdoor restaurant. These improvements completed in 1980 increased public physical and visual access to the CPMA. The offshore mooring area tucked behind the mangrove island had mooring buoys in 1974, but in 1985 the Metro-Dade Parks Department placed experimental prefabricated "star" docks out in the mooring area. Each star dock can accommodate about twenty boats. Except for changes at Cape Florida and Crandon Marina, the rest of the Key Biscayne shoreline remained substantially the same from 1974-1986.

The changes along the shore of the Rickenbacker Causeway spoil islands have affected the activities that take place there. In years past the southern shore of the western spoil island was used almost entirely by Hobie Cat sailors. Over the last few years this shoreline has become severely eroded and armored with more rock than sand. The Hobie sailors have moved to the east Causeway island along the southern shore of Virginia Key where the shoreline is more conducive to launching their craft. Windsurfing has also become a popular pastime along the southern side of the west Causeway island. Windsurfers also use the Virginia Beach area (outside the APMA) and the southern shore of Virginia Key.

Along the mainland of Unit VIII, several changes occurred along the Coconut Grove shoreline during 1974-1985. Just south of Mercy Hospital to the "L" shaped canal, single-family residences were replaced by low-rise apartment/condos and townhouses; with pilings for private dockage, and several single family homes were razed leaving a large vacant area in 1985. The single family character of the shoreline south of the canal remains, however, a lot south of the canal, vacant in 1974, now houses the L'Hermitage Townhouse community, and boat slips. Grove Isle, located just offshore of Coconut Grove was a 20 acre vacant island in 1974. By 1985 three residential towers, a hotel, tennis courts, pool and a marina had been construted at this site.

Since 1974, the Coral Reef Yacht Club added a new dock with approximately 30 boat slips. Monty Trainer's dock was also extended, from 500' to 750'. Although the configuration of the Dinner Key marina docks has remained the same, improvements to the piers and some of the upland facilities have been made.

In the late 1970's the Coconut Grove Sailing Club demolished their old building and built a two-story vernacular clubhouse along the Bayfront. A small number of mangroves have taken root in the riprap along the shore.

South of the Barnacle State Historic site which was purchased by the State in 1973, two estate-density lots were developed into small private communities. "Abitare" is a strip of townhouses with a 200 foot long dock, and "Camp Biscayne" is a single family cluster residential development surrounded by hammock vegetation.

At Cocoplum a number of new waterways and a boat basin have been dredged and mangrove areas have been filled since 1974. A mangrove planting mitigation program was instituted, however, the success rate has been quite low. The boat basin, located just south of the Coral

Gables Waterway and immediately adjacent to the Preserve, was opened as a 104 slip private marina in early 1986.

The County has made over $1 million in improvements at the Matheson Hammock Marina since 1974. Three new 300' long piers with about 100 new wet slips were added to the marina. The boat ramps were improved and six piers were added. These improvements were completed in August of 1983.

Just south of Matheson Hammock Park lies the 640 acre ITT-Snapper Creek property, which was purchased in 1982 using State Conservation and Recreation Land (CARL) funds. Under a management agreement between the State and the County, the Metro-Dade Park and Recreation Department is managing the mangrove and disturbed upland areas, and Fairchild Tropical Gardens is managing the hardwood hammock. Plans for the area include limited public facilities such as boardwalks, nature trails and interpretive area, and canoe launch.

South of Chapman Field Park the Kings Bay Yacht Club expanded their in-water facilities immediately adjacent to the Preserve. In their lagoon, there were a dozen docked houseboats, and about 30 moored sailboats in 1985. Four piers replaced a single pier in their marina and a large hoist replaced a smaller, older one and a ramp.

To the south, Royal Harbor Yacht Club, a waterfront townhouse community with private docking facilities has been developed on the northeastern portion of Paradise Point. Paradise Point itself was created from the spoil that was dredged several decades ago to create what is now known as the FPL channel. On the south side of the Point, Royal Harbor cut approximately 70 linear feet of red mangroves in an unsuccessful mangrove pruning experiment in 1984.

The shoreline between Paradise Point and C-100 has remained substantially the same from 1974-1985. However, in August 1985, Dade County completed acquisition of the 368 acre Charles Deering Estate located along the Bay at approximately SW 167 Street. This site contains some of the finest remaining natural hammock vegetation in south Florida, and a large stand of coastal band mangroves. Historical structures and archeological sites are also found at this and an adjacent privately-owned site. An interim management plan which addresses the immediate need for securing the site, controlling access, and determining what improvements need to be made to the existing structures, has been adopted by the Board of County Commissioners.

<u>Coastal Construction Activities</u>. Between June 1980 and October of 1985, DERM has issued over 80 coastal construction permits in Unit VIII. The estimated cost for this permitted work has been valued at over $1.2 million. New and replacement docks, mooring piles and maintenance dredging accounted for the major portion of the work.

The $1.2 million in coastal repairs and construction in Unit VIII does not include the public projects that were permitted and were completed or underway in 1985. These include an estimated $27 million for the Rickenbacker Causeway and bridge construction and over $2 million for the Crandon and Matheson Hammock Park marinas and ramp expansions.

Unit VIII - 1986

Although Unit VIII has the longest length of shoreline and largest amount of open water area in the entire APMA, relatively few storm water outfalls empty into this area. Of the 57 outfalls over 12" in diameter, only two are greater than 51" in diameter; and both of these empty into the Dinner Key area (Figure 102). In addition large outfalls (between 31" - 50") discharge into the Bay just south of Kennedy Park, and into one of the Sunrise finger canals just above the Gables Waterway. The majority of the remaining outfalls, are concentrated along single family residential areas, and within marinas. There are no stormwater outfalls greater than 12" in diameter south of the Matheson Hammock Park Marina area (DERM, 1980).

Key Biscayne. The Bill Baggs Cape Florida State Recreational Area provides well-utilized public access to the ocean and the Bay along the southern end of Key Biscayne. The central one-third of Key Biscayne's Bay shoreline is predominantly single-family residential bulkheaded shoreline. Many of these homes have docks and a private yacht club is also located along this shore. The northern one-third of the island shore from below West Point to just short of Northwest Point is lined with mangroves with the Key Biscayne Golf Course located just inland of this fringe forest.

Just south of Northwest Point, Crandon Marina has boat slips, dry storage, ramps, gas docks, mooring area, bait shop, restaurant with transient dockage and parking facilities. This facility provides public access to the Bay and Ocean, a restaurant that can be reached by boaters, and views of the marina from the restaurant.

Virginia Key. Across Bear Cut from the northern tip of Key Biscayne and the Crandon Park Marina is the Rosenstiel School of Marine and Atmospheric Sciences. This facility is the home base for scientists and research vessels that undertake marine and oceanic research throughout the world. Immediately to the west is the Seaquarium which houses collections of fishes, marine mammals and birds. At the western end of the Seaquarium there is a docking facility where tour boats provide daily access to and from this facility.

Rickenbacker Causeway. As discussed below, the recently widened Rickenbacker Causeway provides both physical and visual public access to the APMA. The Rickenbacker Causeway construction included landscaping, a bike path, designated parking areas and a perimeter access road which effectively separates the through causeway traffic from local traffic seeking parking or access to the beach. This has eliminated the formerly dangerous situation where anyone could pull off and park anywhere along the south side of the Causeway. While this is much better from the standpoint of day-to-day use and safety, it has eliminated some of the overflow parking that was used during events at the Marine Stadium.

FIGURE 102

STORM WATER OUTFALLS

- ⊥30"
- 24-30"
- 12-23"

SOURCE: METRO-DADE DERM, 1981 &
METRO-DADE PLANNING DEPT., 1986

As mentioned previously, the old Rickenbacker bridge has become a fishing pier, providing public landside access to one of the best fishing areas in the Preserve area. This causeway is under the jurisdiction of the County's Public Works Department.

Mainland Shore. Alice Wainwright Park is located just south of the Rickenbacker Causeway along the mainland shore. This park provides public visual access, but except for allowing fishing from the bulkheaded shore, it does not provide any water-oriented activities or physical Bay access. Even the educational displays at this park do not address its waterfront location. Between Wainwright Park and Vizcaya, the land use is estate-density residential.

Vizcaya, an historic villa and gardens, and a County Park, offers gondola rides in addition to the wonderful views of the central Bay area. South of Vizcaya is a private school with chapel and the Mercy Hospital/Medical Building complex, which has a narrow grassy area with concrete walkway along its fenced-in shoreline. Along the bulkheaded shoreline is a dock with a direct phone line to the emergency room. Although there are a number of other hospitals located along the Bayshore, this is the only private medical facility which provides emergency services specifically designed for boaters' access.

Residential uses dominate the shoreline between Mercy Hospital and Kennedy Park. Kennedy Park provides spectacular views of the central Bay, but no physical access. A small sailboat and catamaran rental facility and Biscayne Bay and Coral Reef Yacht Clubs are located south of Kennedy Park.

Dinner Key. The Yacht Clubs and Monty Trainer's docks, raw bar and restaurant are the northernmost facilities in the Dinner Key area. This area has evolved into a curious mixture of historic "old Grove" versus "new Grove" and marine oriented versus nonmarine uses. Here in close juxtaposition are found a parking lot fronting the Bay and the Virrick Boxing Gym and Merrill Stevens and Grove Key Marinas. Merrill Stevens and Grove Key boat yards are located along City leased Bayfront, both of which provide marine-industrial and commercial services. Merrill Stevens also provides wet and dry slips, while Grove Key only has dry boat storage available. Along the shore, tucked between these two boat yard operations, are two waterfront restaurants. While the Chart House restaurant has large windows fronting the Bay, it does not take advantage of its Bayfront location. Captain Dick's Tackle Shack Restaurant, on the other hand, has picnic tables and covered outside seating along the Bay. Boaters can also gain access to this restaurant.

Just south of the two commercial boat yards is the City's Dinner Key Marina, with its five long piers and many liveaboard vessels. Adjacent upland facilities include the City Hall, and the marina's parking, showers, and laundry. South of Dinner Key are the City's boat ramps and Ken Meyers Park, with picnic tables along the Bay. The Dinner Key area provides more concentrated public access to the Bay than any other Bayside location. The most recent in a long series of Dinner Key master plans was adopted in 1984 and amended in 1985.

The Coconut Grove Sailing Club, with three small dinghy docks and moored boats is located between Ken Meyers Park and Peacock Park. Peacock Park has softball diamonds on the Bay. The public uses the shoreline for viewing the Bay even though the Park's design and use during concerts and other special activities discourages shoreline use. Ultra-light plane enthusiasts launch their craft from the shore of this Park for aquatic take-offs south of the Grove Sailing Club moorage area.

South of Peacock Park is a vacant lot and the Barnacle State Historic site. Ralph Munroe's historical home and boat house grace the Bayfront, waterward of a lovely hammock area. The rest of the Coconut Grove shoreline between the Barnacle and the Coral Gables line is predominantly estate and low density residential development; except for two developments, near downtown Coconut Grove, where townhouses and single-family cluster developments are found. This shoreline is irregularly shaped with a number of small private inlets, canals and tiny boat basins.

Coral Gables. From the Coral Gables line to the Gables Waterway, the shoreline is primarily single-family residential, bulkheaded and more regularly shaped. Along the northern shore on the Coral Gables Waterway there are single family homes on finger canals and a large vacant lot. West of the vacant lot there are two high density residential buildings with private docks. From there west to the LeJeune Road bridge, estate density residences dot the shore with attendant private docking and small boat houses. On the south side of the Gables waterway in the Cocoplum development many lots remained vacant in 1985 as did most Cocoplum lots located along the Bayfront. South of Cocoplum the Gables Estates and Old Cutler Bay subdivisions consist of bulkhaded and regularly shaped shoreline developed in large estate homes.

South of Gables Estates is Matheson Hammock Park, with boat slips, ramps, dry storage, swimming area, bike paths, picnic and parking facilities. This area affords some of the best, most widely used public physical access to the central Bay area even though a large percentage of the park shoreline is lined with mangroves.

South of Matheson, the former ITT Property straddles Snapper Creek. This publically owned parcel includes more than six hundred acres of mangroves and an extensive tropical hardwood hammock with interesting geological formations. A master plan, prepared by Dade County includes provisions whereby the property will be jointly managed by the Dade County Parks and Recreation Department and Fairchild Tropical Garden. This site will be used for nature study and low key activities such as nature tours, canoe launching and picnicking. The tip of this property juts out several hundred feet into the Bay on the north side of Snapper Creek and provides spectacular views of the CPMA from Matheson Hammock south.

South of the ITT property is Gables-by-the-Sea, the last of the 1950's style subdivisions with exclusive, large, single family homes along finger canals. Bay access is limited to those who own boats and keep them adjacent to their residential property.

Just south of Gables-by-the-Sea is the Chapman Field Park site. Except for the upland area near Old Cutler Road, this park is substantially undeveloped and consists of an extensive mangrove forest with tidal creeks, a large dredged lake, several acres of disturbed uplands and roadways, and offshore tidal flats and shoals. This area is ideal for, and is currently used for canoeing. Just outside of the Preserve, the Kings Bay Yacht Club docks about a dozen houseboats and 30 moored sailboats in a lagoon north west of Chapman Field's southern tip; and to the south and west there is a boat basin that includes the private Kings Bay marina and a bulkheaded shoreline that is used by the adjacent private residents for boat dockage. Both the Air Force and Florida Power and Light have private docks and ramps in this area. Small mangrove islands abound in the shallows around the channels leading to the lagoon, boat basin, and canal in this area. Also located just outside of the Preserve, but a major landmark looming out over the mostly vegetated central Bay shoreline, are the Cutler Power Plant stacks.

Mainland Shore South of Coral Gables. Royal Harbor Yacht Club, a private townhouse and marina community was being developed on the tip of Paradise Point in 1985, on the north side bordering the channel into the FPL Cutler Plant and Kings Bay Yacht Club. The mangrove shoreline was substantially trimmed and partially destroyed. The southern Bay shoreline of this project is still lined with mangroves. As mentioned previously an unsuccessful mangrove pruning experiment killed mangrove trees on the southern side of this property.

Royal Palm Drive leads from SW 152 Street to the edge of the Bay; allowing small boat launching and visual access to the central Bay. The shoreline both north and south is mangrove. South of Royal Palm Drive is the recently-purchased Deering Estate. Except for the boat basin area in front of the main house, the entire shoreline south to the C-100 canal is banded by mangroves. The mangrove area north of the boat basin is quite wide and thins out to about 400' in width south of the basin to C-100.

Just offshore of Paradise Point and south of Chapman Field is Chicken Key. The mangroves along the western edge of this natural island and the offshore shallows keep boaters away from this area and hence the wading and other birds that use these areas. The eastern shore is accessible by boat, and people are known to camp on the uplands along the northern and central portions of the island.

In-Water Activities. Although Unit VIII is wide, and the waters deep along its north/south axis, the waters are protected by Key Biscayne and the network of sand flats which comprise the shallow Safety Valve area. Bear Cut and various channels south of Key Biscayne provide direct access to outside ocean waters. Figure 103 generally indicates some of the most prevalent of the hubbub of in-water activities that occur in Unit VIII.

One of the most concentrated and often-times crowded areas in terms of both shoreline and in-water activities is south of the Rickenbacker Causeway. Hobie Cat sailors, windsurfers, swimmers, waterskiers, jet skiers, small boat operators and fishermen all vie for space along the shores and in the waters off Rickenbacker. As described in earlier sections, the new Causeway construction has brought a number of improvements to this area. Jurisdiction of this area remains within the County Public Works Department and not with the County Parks Department. For this reason the rules which usually govern parks, such as "no pets", parking fees, and other restrictions, do not apply.

Boaters can sail and power about without having to remain within the usually narrow confines of the intracoastal waterway. Along the western side from the Coral Gables Waterway southward, the Bay shallows considerably, and boat access to and from shoreline facilities and docks is limited to dredged channels. In this shallow area canoes and shallow draft skiffs run into and out of the various canals and up to the tidal creeks located in and around Chapman Field, Matheson, the ITT and Deering Estate properties. An informal boat ramp/launch is located at the end of Royal Palm Drive (south of Paradise Point). Canoes and small sailboats are launched from this street-end and can be seen in the basin bounded by Chicken Key.

In addition to the boating-related facilities at the Matheson Hammock Marina, the bike paths, picnic areas, and swimming lagoon draw large crowds to this County park. The ITT Chapman Field and Deering Estate properties are currently inwardly directed and direct water access is not yet available from any of these County facilities.

On almost any given weekend there is a sailboat race going on along the wide expanse of Unit VIII. According to Sharp (State of the Bay, 1984), over 40 local races and 20 special sailboat racing events are sponsored annually by the various yachting clubs located along the shore of the Bay.

Just off the Cape Florida channel in Bill Baggs State Park is a small boat basin, locally referred to as "No Name Harbor", which is used by local boaters as a weekend anchorage, and by out of town boaters. Another anchorage area, known as "Hurricane Harbor" is located in the inlet just north of Southwest Point on Key Biscayne where single family residential uses predominate. This is an open area of water that is well protected by the surrounding land. Both of these informal anchorages support a very small number of mostly transient boats. A very concentrated, somewhat rundown, more permanent area of anchored boats is located just offshore of Dinner Key. In February 1985 164 boaters were anchored in this area. This area has served as a free, traditional anchorage for many years.

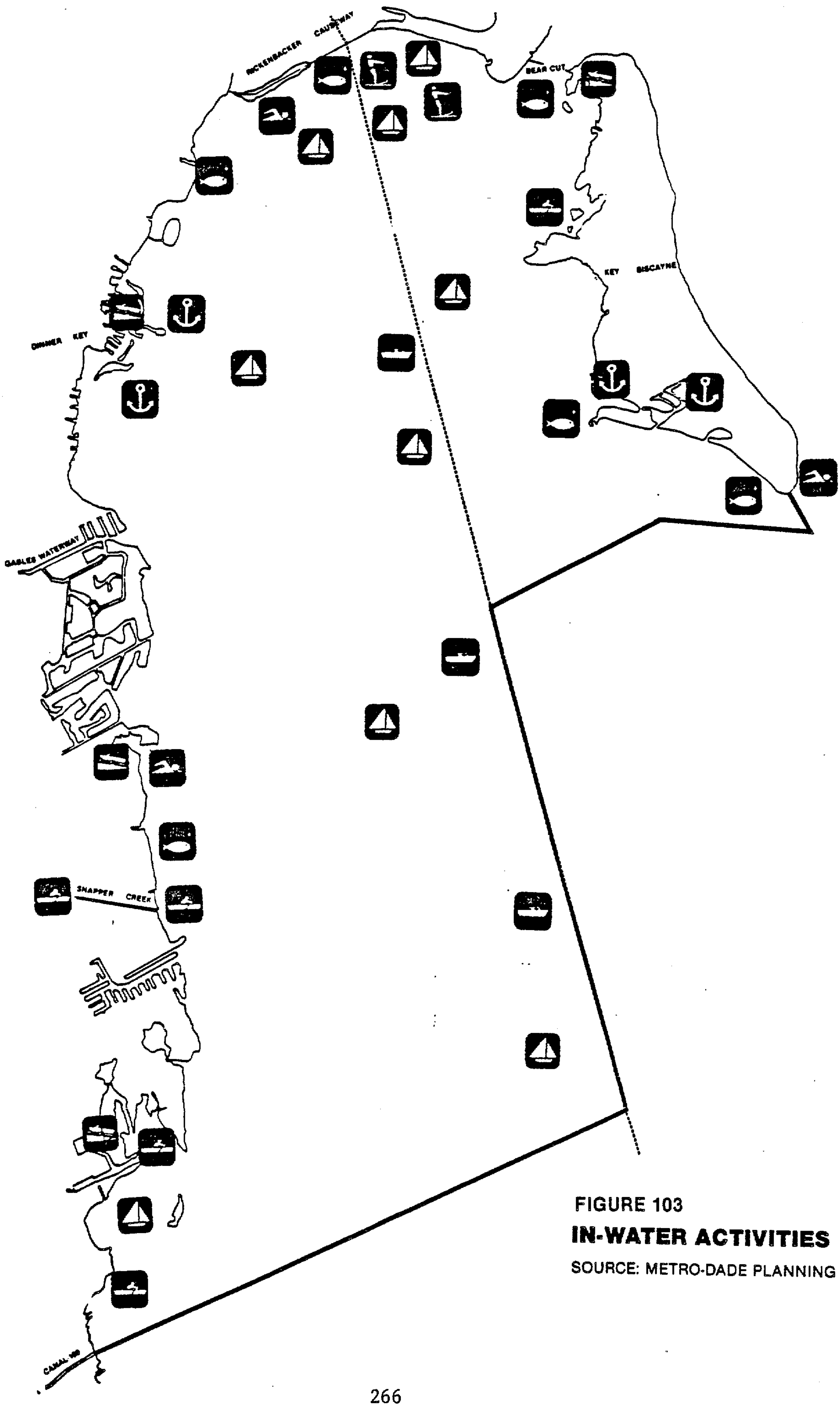


FIGURE 103
IN-WATER ACTIVITIES
SOURCE: METRO-DADE PLANNING DEPT., 1986

In addition to the anchorages mentioned above, Table 20 lists the public and private marina facilities with 10 or more spaces that line the shores of the CPMA (Figure 104). According to an inventory of docking facilities done by DNR (1984), all of the CPMA marinas, except one, have an 80% or greater occupancy rate. These marinas provide a total of 1,851 wet slips and 818 dry slips. In addition to the boats that are docked or moored at these facilities, a boat count done in February 1985 revealed that 196 boats were docked outside of marinas within Unit VIII, and there were an additional 66 boat spaces outside marinas within the Preserve area that were empty.

Because the CPMA is so large and so widely used, a boat count for marinas and docks was done for the waterways and areas adjacent to Unit VIII. Table 21 lists marinas with 10 or more spaces adjacent to the CPMA. In addition to these facilities, there were 485 boats docked outside of marinas just outside of Unit VIII. There were only 6 boats anchored and there were, conservatively speaking, 336 empty boat slips adjacent to the CPMA (Metro-Dade Planning Department, 1986).

Fishing within Unit VIII is widespread, and takes place from the landside, from bridges and from boats. Along the Cape Florida Channel the fish are especially diverse because of incoming tides from the Atlantic. Along the old bridges and catwalks of the Rickenbacker Causeway, people are always fishing with rods and shrimping with nets. In the deep waters just offshore of Mercy Hospital, a new artificial reef was constructed in 1985. Boaters can often be seen over this spot. The shallow seagrass areas south of Matheson Hammock Park are known as trout flats by local fishermen. People can frequently be seen working cast nets along these shallows. Lobster pot buoys can be spotted throughout the basin, mostly in the deeper central portions. Commercial shrimping, carried out by vessels docked in the Dinner Key and Black Point areas, generally takes place in southern Biscayne Bay, but also extends into the Southwestern corner of Unit VIII.

Submerged Land Ownership. Figure 105 details the submerged Bay bottom ownership of Unit VIII. This information is based upon State of Florida DNR (1977), Dade County Engineering Department (1977), City of Miami Public Works (1969), and Dade County Parks and Recreation (1986) maps but remains unverified by the Florida DNR. The great majority of this unit is still within State of Florida ownership. The City of Miami owns a portion of the northern limits of the central preserve area offshore of Rickenbacker and another portion in the Dinner Key area. The County owns the Bay bottom adjacent to the Rickenbacker Causeway, along the western shores of Key Biscayne, and a small portion off Matheson Hammock Park.

TABLE 20

Marinas With More Than Ten Slips In Unit VIII

No.	Type	Facility	Boat Ramps	Wet Slips & Moorings	Dry Racks
62	Public	Crandon Marina* 400 Crandon Blvd Key Biscayne 33149	14	280	88
63	Private Club	Key Biscayne Yacht Club 180 Harbor Dr Key Biscayne 33149	1	100	43
64	Condominium	Grove Isle Marina** #4 Grove Isle Drive Miami 33133	--	85	--
65	Private Club	Coral Reef Yacht Club 2484 S Bayshore Dr Miami 33133	--	98	80
66	Private Club	Biscayne Bay Yacht Club 2540 S Bayshore Dr Coconut Grove 33133	1	30	30
67	Commercial	Monty Trainers Bayshore Marina 2560 S Bayshore Dr Miami 33133	--	155	0
68	Commercial	Merrill Stevens Yacht Yard 2640 S Bayshore Dr Miami 33133	--	55	100
69	Commercial	Grove Key Marina 3385 Pan American Dr Miami 33133	--	--	350
70	Public	Dinner Key Marina* 3400 Pan American Dr Coconut Grove 33133	1	374	0
71	Private Club	Coconut Grove Sailing Club 2990 S Bayshore Dr Miami 33133	--	272	36
72	Condominium	Water's Edge Condominium Assoc. 100 Edgewater Dr Coral Gables 33133	--	18	0

Table 1 (continued)

No.	Type	Facility	Boat Ramps	Wet Slips & Moorings	Dry Racks
73	Condominium	Gables Waterway Towers 90 Edgewater Dr Coral Gables 33133		27	0
74	Condominium	Gables Harbour Condominium 6901 Edgewater Dr Coral Gables 33133	--	23	0
75	Public	Matheson Hammock Park* 9601 Old Cutler Rd Coral Gables 33156	11	252	71
76	Commercial	Snapper Creek Marina 11190 Snapper Creek Rd Miami 33156	1	31	20
77	Condominium	Royal Harbour Yacht Club 6200 SW 152 St Miami 33157	--	51	0
TOTALS			29	1,851	818

TOTAL Wet and Dry Slips = 2,669

Note: Except for Royal Harbor Yacht Club (where purchase of a unit includes a wet slip and where build-out is only 25% complete), all marina facilities in Unit VIII have at least 80% occupancy (DNR, 1984).

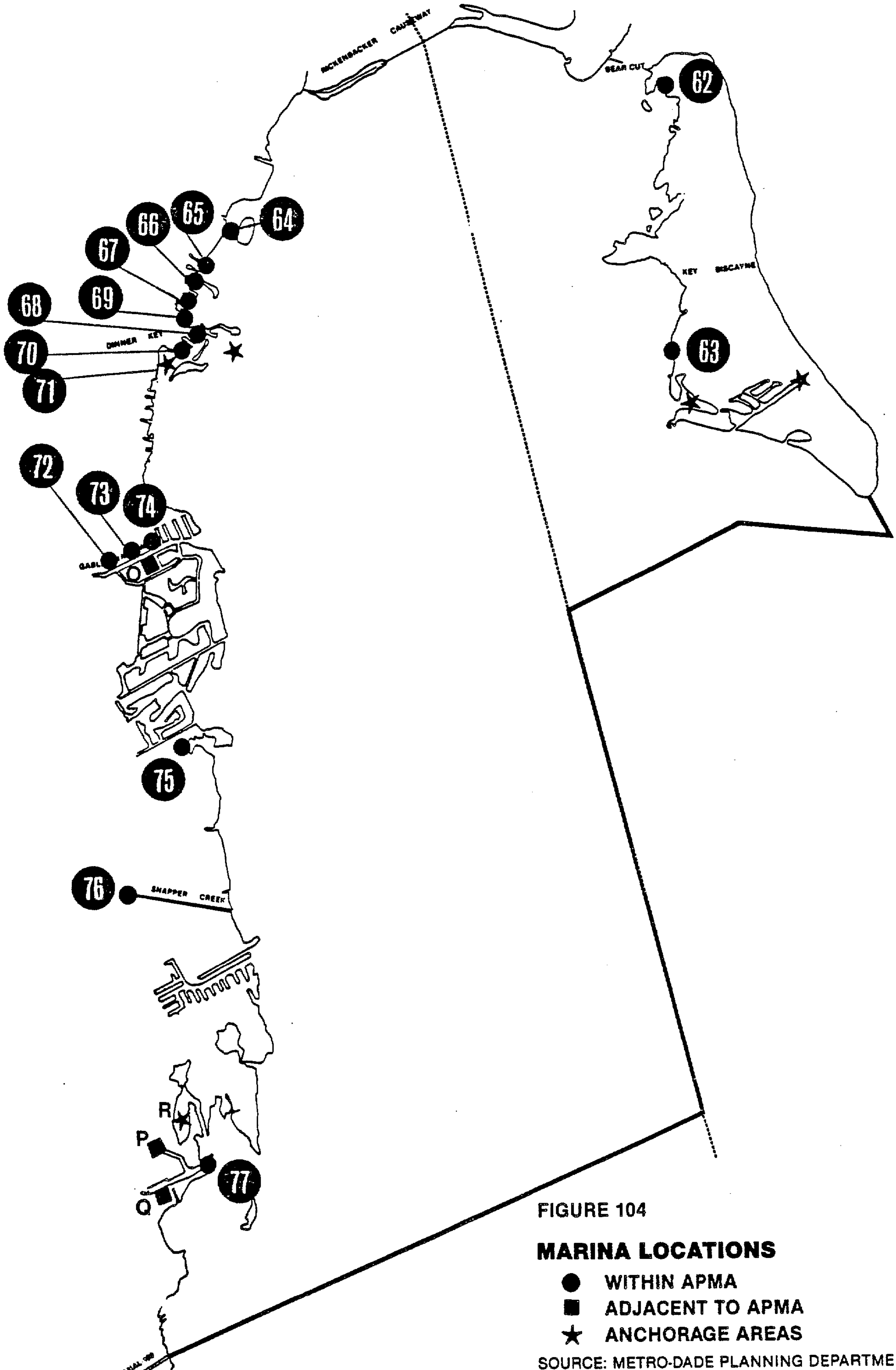


FIGURE 104

MARINA LOCATIONS

- ● WITHIN APMA
- ■ ADJACENT TO APMA
- ★ ANCHORAGE AREAS

SOURCE: METRO-DADE PLANNING DEPARTMENT, 1986

TABLE 21

Marina Facilities With Ten or More Slips
Adjacent to Unit VIII

Type	Facility	Boat Ramps	Wet Slips & Moorings	Dry Racks
Private Club	Cocoplum Marina 185 Cocoplum Road	---	104	---
Private Club	Florida Power & Light Club Marina 14925 SW 67 Ave Miami 33157	1	11	0
Private Club	Kings Bay Yacht & Country Club 14401 SW 62 Ave Miami 33158	1	170	120
Public	Homestead Bayfront Park Marina Homestead, FL (Phase I - Complete) Phase II - Proposed	10	173	0 265 [2]
Commercial	Pirates Spa Marina 8701 SW 248 St Homestead, FL	---	10	60
Public	Biscayne National Park Elliot Key		641[2]	
Public	Black Point Marina <u>-Phase I - Under Construction</u> (12/87 Completion date	10	178	62
	<u>-Phase II - Proposed</u>		176[2]	300[2]
TOTALS		22	646	242

[1]Limited to transient use for BNP visitors and <u>not</u> included in the boat dock totals

[2]Construction of Phase II will depend on subsequent State approval based on one year of adequate water quality data after completion of Phase I; <u>not</u> counted in boat slip count totals.

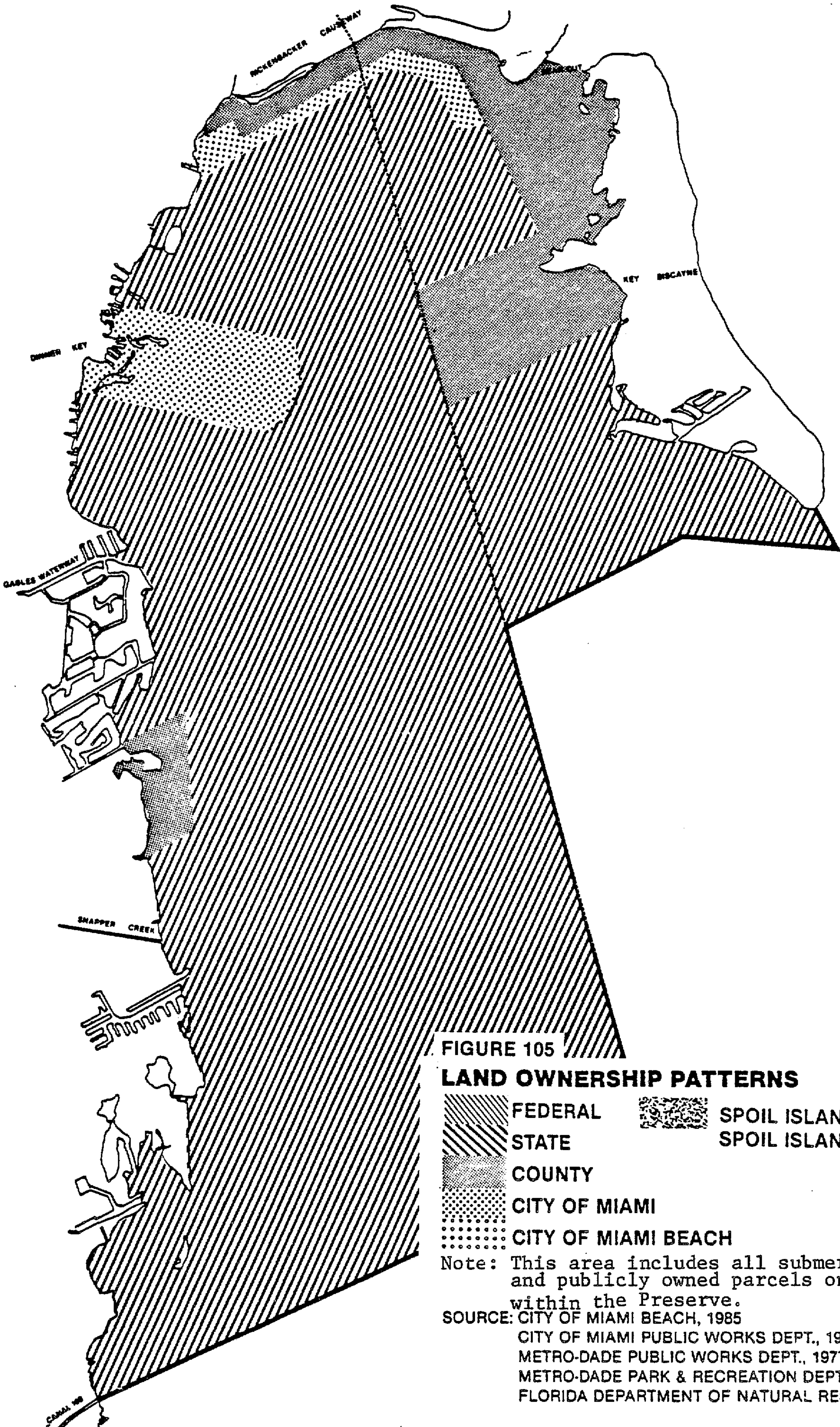


FIGURE 105
LAND OWNERSHIP PATTERNS

FEDERAL
STATE
COUNTY
CITY OF MIAMI
CITY OF MIAMI BEACH
SPOIL ISLANDS & SPOIL ISLAND EASEMENTS

Note: This area includes all submerged lands and publicly owned parcels on islands within the Preserve.

SOURCE: CITY OF MIAMI BEACH, 1985
CITY OF MIAMI PUBLIC WORKS DEPT., 1969
METRO-DADE PUBLIC WORKS DEPT., 1977 & 1981
METRO-DADE PARK & RECREATION DEPT., 1986
FLORIDA DEPARTMENT OF NATURAL RESOURCES, 1977

NOTE: THIS INFORMATION HAS NOT BEEN REVERIFIED BY FDNR DURING THIS PLANNING PROJECT

UNIT VIII

MANAGEMENT OPPORTUNITIES

The following location specific opportunities exist within Unit VIII for implementing the General Management Recommendations presented in Chapter 1. These suggested actions are grouped under the general headings of water quality, resource conservation, vessel storage and use, public access and public safety to track the organization of the General Management Recommendations. The numbers correspond to those shown on Figure 106.

Water Quality

1. Stormwater Outfalls. From the standpoint of size and location, the outfalls in the Dinner Key area and at the end of 22 Avenue, in Kennedy Park, should be eliminated or redesigned to minimize the impacts of pollutants in the first inch of rainfall on the quality of the Preserve.

2. Shoreline Stabilization. The shoreline stabilization projects recommended in the Dinner Key Master Plan (amended 1985) should be given high priority. Portions of the Rickenbacker Causeway that are not used by the public and are not prime shorebird habitat should be stabilized.

Resource Conservation

3. Mangrove Planting. The mangrove revegetation projects recommended in the Dinner Key Master Plan (as amended in 1985) should be implemented.

4. Rickenbacker Causeway. The southeastern end of the Rickenbacker Causeway, adjacent ot the Seaquarium, should be recognized as a prime shorebird area.

Vessel Storage and Use

5. Dinner Key. The recommendations contained in the Dinner Key Master Plan (as amended) should be implemented as quickly as possible. These include: expansion of the Dinner Key marina; improvements at the Seminole boat landing; construction of a new boat dock at the site of the existing ramp at the Virrick Gym; closure of the existing anchorage and provision and policing of a new offshore moorage area; and maintenance of a full service marina with a minimum of 125 wet slips and 470 dry racks.

Public Access

6. Snapper Creek. Public access should be provided at the Snapper Creek/ITT site on the north side of the Snapper Creek Canal. The existing locked gate structure should be moved to permit car access into the disturbed area adjacent to Old Cutler Road and a canoe launch should be constructed in this area. A paved bike path and jogging trail should be installed along the existing dirt road, but access to this path should be controlled and not open to motorized vehicles except for police and service

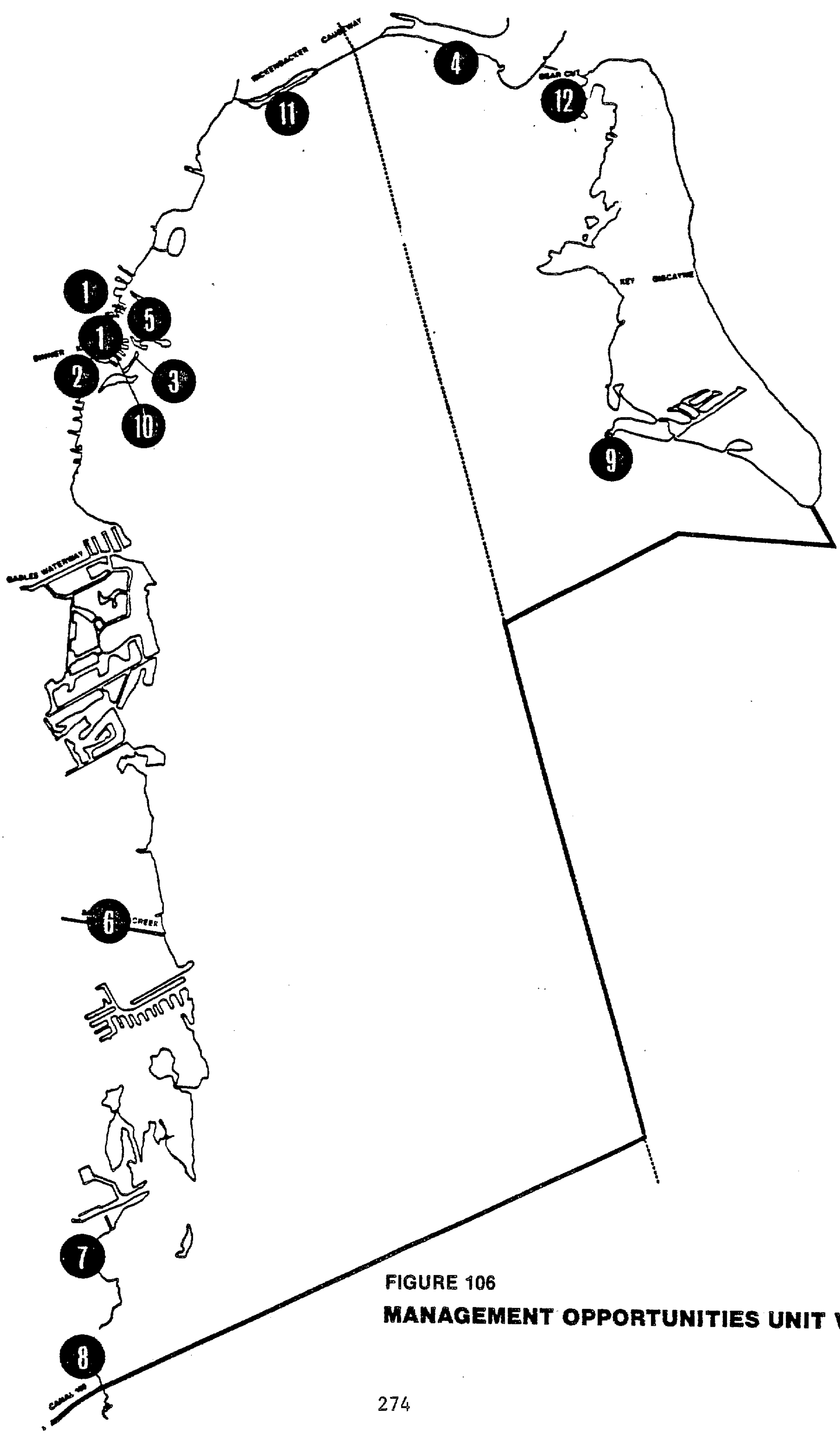


FIGURE 106
MANAGEMENT OPPORTUNITIES UNIT VIII

vehicles. The peninsula should be cleaned, policed and provided with more benches and picnic tables.

7. Royal Palm Drive. The area that is used as an informal small boat launching area should be cleaned up, policed and upgraded. The fishing pier should be repaired, and limited picnicking facilities should be provided.

8. Roadway South of the Deering Estate. This area should be cleaned up and a pier and small boat launching area should be installed. The traditional uses of this area for fishing and boating should be preserved.

9. Mashta Point on Key Biscayne. The traditional public use of this area should be preserved and the area should be cleaned up.

10. Dinner Key. As recommended in the Dinner Key Master Plan (as amended in 1985) construction of the Dinner Key Bay Walk and Bayshore Premenade at McFarland Street should receive very high priority. Construction of a water oriented dock structure in Peacock Park and upgrading of the shoreline at this park should also be given priority.

Public Safety

11. Rickenbacker Causeway. The conflicting uses along the south side of the Rickenbacker Causeway should be more closely policed. Jet Skiing should not be permitted on the south side of the Causeway and an idle speed/no wake zone should be strictly enforced within the swimming and sailing areas immediately south of the Causeway.

12. Boating Safety. An idle speed/no wake zone should be strictly enforced at the junction of the entrance to the Crandon Marina Channel and within the channel itself.

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CHAPTER 9

THE MIAMI RIVER

INTRODUCTION

In order to understand the origin and functions of the Miami River in its natural state, it is necessary to consider two major topographic areas: the Atlantic Coastal ridge and the Everglades. The Everglades area is only about 5,000 years old. Prior to the 1900s, the Everglades comprised the lower portion of a nine thousand square mile, naturally integrated drainage system. Lake Okeechobee sat at sea level in the middle of this system, and received drainage from the entire Kissimmee River Basin.

Under natural drainage conditions, most of the Kissimmee River Basin, Lake Okeechobee and Everglades areas remained inundated throughout the year. During wet seasons water flowed over several miles of the Lake's southern shoreline into the Everglades. When the Lake's water levels reached 19 feet above sea level (msl), a sheet of flood waters poured into the Everglades over the entire southern shore. This sheet flow followed a number of paths out of the Everglades: it continued to creep almost imperceptibly southward to Florida Bay and it flowed out through troughs and valleys, or "transverse glades" and natural streams in the Atlantic Coastal Ridge. Also freshwater flowed eastward through the porous limerock forming natural freshwater springs within Biscayne Bay (Parker, 1974).

While the Everglades remained flooded most of the year, the coastal ridge served as a dam impounding these interior waters. This natural dam, averaging five miles in width with elevations of between eight and 21 feet, contained the dry weather low water levels of the Everglades (Parker, 1974).

In the Miami River, freshwater flowed across the natural fall line in the coastal ridge, commonly referred to as the Miami River Rapids (Griswold, 1896 in Parker, 1974). The "rapids" were located in the vicinity of NW 27 Avenue. These natural conditions remained unchanged until the early 1900's.

Historical Background

Throughout the world, major cities have developed along oceans, natural embayments, rivers and streams. Although relatively young, Miami has followed this same course. Sequentially Indians, Spaniards, Englishmen, Bahamians and North American settlers chose the banks of the Miami River for their settlements.

From as early as 2,000 B.C. Tequesta Indians had settlements along the Miami River. The Tequesta Indians were dispersed in seminomadic maritime settlements along the Bayshore, rivers and the Everglades, but their major settlement was the village called "Tequesta" by the Spaniards, on the north side of the mouth of the Miami River. They moved easily between the Bay and the Everglades through the natural waterways.

The Spaniards built their first local settlement, a mission and a fort on the periphery of the Village of Tequesta in 1567. At that time the Indian population was at its maximum of about 5,000 inhabitants. The mission was abandoned in 1570 due to the fierceness of both disease and the Indians. It was not until 1743 that the Spaniards attempted a second settlement, by which time the Indian population had declined due to disease, warfare and an exodus to Cuba. (Carr, personal communication).

By the beginning of British rule in 1763, the Indian population had totally disappeared (Chardon, 1976), and for the next 40 years there were no settlements along the River. However, Bahamians came into the area to salvage wrecks on the reefs, to fish, and to hunt turtle.

In the early 1800s both white settlers and Seminole Indians established settlements along the Miami River. In 1830, only nine years after Florida was ceded by Spain to the United States, Richard Fitzpatrick bought four square mile land grants along, and south of, the Miami River for just over $2,000, or $500 per square mile (Parks, 1981). Fitzpatrick brought in slaves to clear hundreds of acres of hammock, and started a plantation consisting of coconuts, sugar cane, pumpkins, limes, corn, sweet potatoes and tropical trees from the West Indies (Parks, 1984). He built a house on the River's north bank and slave quarters on the south bank, and asked the government to survey and open the area to other planters.

In January 1836 the slaves and white families on Fitzpatrick's plantation were panicked by news of an Indian attack at the New River. They fled to the Cape Florida lighthouse where they were taken by ship to Key West. Later in 1836 Fitzpatrick was elected president of the Territorial Legislative Council and a new and separate county of Dade was formed even though there were no settlers and the area was under Indian control (Parks, 1981).

Due to conflicts between the settlers and the Indians, several military installations were alternately established and abandoned along the Miami River. In February 1838 the Navy and Army sent units to the vacated and burned Fitzpatrick plantation where they began to build log houses and named the site Fort Dallas after Navy Commodore Alexander James Dallas. Within a few weeks it became obvious that moving men and supplies into Fort Dallas was difficult due to the shallowness of the Bay and the tricky shoals at the mouth of the River. These units were evacuated to Key Biscayne, where Fort Bankhead was established. In 1839 the Army sent units back to Fort Dallas to establish Fort Miami at the River's head-waters (Parks, 1984). Within a few days the Fort Miami unit was ordered back to Fort Dallas. On the canoe trip down the River they were ambushed by Indians and their captain was killed. By June 1839 all troops were once again withdrawn back to Key Biscayne, where Fort Bankhead was renamed Fort Russell in honor of the slain captain.

In October 1839 Fort Dallas was again occupied to ward off an increase in Indian attacks along the mainland. (Parks, 1984). While the Army withdrew from the Fort, the Navy and Marines remained at the site until July 1842, when the few remaining Seminoles were believed to have retreated deep into the Everglades.

In 1842 at the unofficial end of the Second Seminole War, the U.S. Congress passed the Armed Occupation Act. This granted title of 160 acres of land to the head of any family who cleared five acres, built a home and occupied the site for five years. It was assumed that this would encourage settlement and that the settlers would take care of their own Indian problems.

According to Parks (1984), the mid and late 1840's became a time of growth and optimism for the Miami area. Fitzpatrick sold his ruined plantation to his nephew William English for $16,000. English, the first to call the area Miami (meaning sweet water), moved to the north bank of the River. He platted the "Village of Miami" on the south bank, and began selling lots for one dollar each (Parks, 1981). In 1844 the Dade County Seat was moved from Indian Key in present day Monroe County, to the mouth of the Miami River.

In the mid 1840's George Washington Ferguson and Thomas Jefferson Ferguson, brothers, began operating Miami's first manufacturing establishment: a waterpowered comptie starch mill on the North Fork Miami River at the natural "riffle" or rock formation, referred to as the River Rapids (Figure 107). Comptie starch, made from the root of the native cycad plant Zamia, was the area's only cash crop. By the 1850's the Ferguson brothers employed 24 people, manufactured 300,000 pounds of comptie starch at a value of $24,000 (Parks, 1981). In the mid 1840's Dr. R. R. Fletcher, formerly of Indian Key, began operating a store in a large two story building on the south side of the River, opposite English's house. Fletcher also started a starch mill operation on the southern bank farther up the River (Parks, 1981).

In 1849 word reached Miami that the Indians had once again attacked at Indian River. While English was seeking assistance from the U.S. Government, all of the Miami River settlers fled to the newly reconstructed Cape Florida lighthouse. In September 1849 the Army reestablished Fort Dallas on the site of English's home and the log houses of the old Fort Dallas. With troops occupying his plantation and the settlers gone, English joined the 49'er gold rush in California in hopes of finding the capital he needed to build his dream city of Miami. However, he would never return because he accidentally shot and killed himself while dismounting a horse (Parks, 1981).

In December 1850 the troops were again withdrawn from Fort Dallas. As the Indian scare died down, settlers trickled back to the Miami River area. With English gone, George Ferguson became the new community leader and in 1852 he urged the U.S. government to help out with the Indian situation. In 1855 the Army reestablished Fort Dallas for the fifth and last time. This was the largest occupation of the Fort. During the next three years a large number of buildings were added to the site, alongside the two-story stone structure that English had built. The Army added a hospital, stable, bake house, blacksmith shop, two kitchens, guardhouse, office, storehouse and officers' living quarters. During this occupation there was only one minor Indian attack in the Coconut Grove area. In May of 1858 the troops were withdrawn for the last time from Fort Dallas.

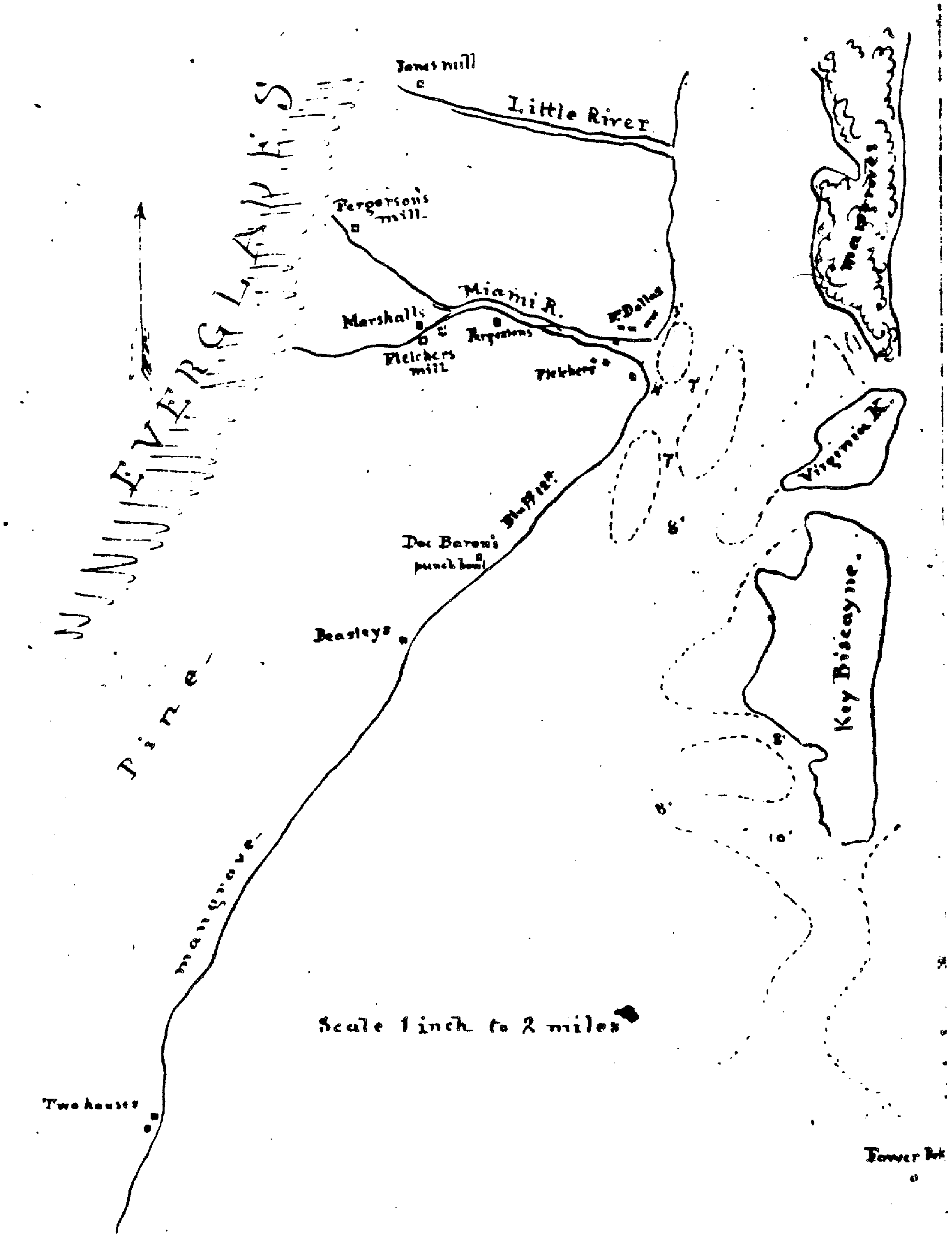


FIGURE 107

MIAMI RIVER SETTLEMENT IN 1840's

SOURCE: PARKS, 1981
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

Miami was cut off by the naval blockade during the Civil War and the mail boat was also suspended, further isolating the River area inhabitants. After the Civil War ended, a scouting party was sent to Miami to explore the feasibility of the area becoming another Liberia, the home for 50,000 freed slaves from Virginia (Parks, 1981); however, this idea never materialized.

In the late 1800s there was an increase in the numbers and permanence of white settlers in the Miami River area. In 1870 William and Mary Brickell settled on the south side of the Miami River at Brickell Point (current location of the Brickell Point Holiday Inn). Here they established a popular Indian trading post where Seminoles exchanged meats, alligator and other skins, and egret plumes for fabric, beads and sewing machines and materials.

In 1873 the Army sent some troops to "Camp Dallas," which was owned by a Dr. Harris, who had purchased it from English's mother. Harassed over ownership of the Fort Dallas site and unsuccessful in some agricultural ventures on the property, Dr. Harris sold his land to the Biscayne Bay Company of Augusta, Georgia, which assigned caretakers to the Fort Dallas property. From 1875-1877 the Lovelace family ran a Boarding House which Julia Tuttle visited in 1875. In 1891 Julia Tuttle returned to Miami and purchased the Fort Dallas tract from the Biscayne Bay Company. She improved and moved into the two-story stone building that had once been English's house. After the disastrous freezes of 1894-5, Julia Tuttle convinced Henry Flagler to continue his railroad to Miami, promising him the Bayfront half of her tract along the north side of the River.

While the banks of the Miami River were cleared of vegetation during the early years of settlement, natural growth took over as the land was abandoned or left uncultivated. According to Parks (1984), the impact of man's activities along the Miami River banks was only minimal through 1895.

The Beginning of a City. By the spring of 1896 Flagler's (FEC) railroad reached Miami, opening this isolated, wilderness area to railroad workers and tourists. Later in the year of 1896 the City of Miami was incorporated. During this same year Flagler began construction on the Royal Palm Hotel, at the River mouth (site of the Dupont Plaza parking lot). Flagler spent $20,000 cutting a channel across Biscayne Bay and into the River so that guests could bring yachts to his hotel docks. In the process, he deposited the dredged marl and shell material on Brickell Point, blocking the Brickell family's view of the Bay and River (Muir, 1953).

In preparation for the opening of his hotel, Flagler had crushed oolitic limestone roads laid out in a simple grid pattern and he installed water and sewer lines along Avenue D and 14th Streets (see Figure 108). The effluent from these sewer lines was discharged raw into the River from a single outfall under the Avenue D bridge (Peters, 1984). By 1909 the sewage discharge area had become unsightly and unhealthy, and the outfall line was extended 50 feet farther into the River and lowered to a depth of 9 feet (Peters, 1984). In 1910 the sewer system was expanded and a

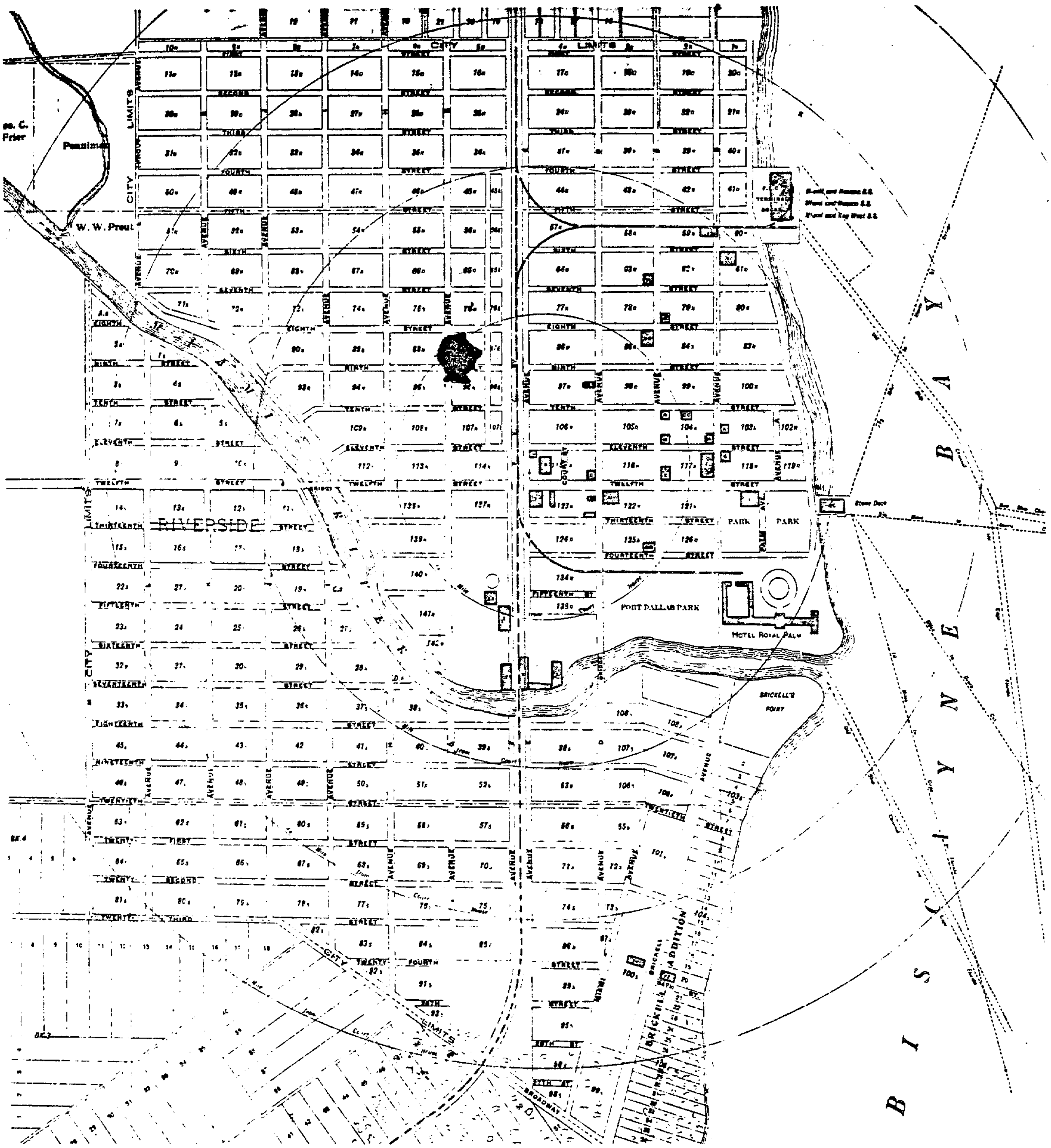


FIGURE 108

MIAMI'S FIRST STREET LAYOUT

SOURCE: PETERS, 1984
HISTORICAL MUSEUM OF SOUTHERN FLORIDA MAP FILES

trunk line emptied the raw sewage into Biscayne Bay "...400 feet from the end of 2nd Street (now NE 10 Street)...into a channel that carried all deposits into the ocean..." (Straight, 1973).

Garbage disposal was also a problem for the rapidly growing City of Miami. Dr. Jackson, Miami's local agent for the Florida State Board of Health, issued a directive published in the Miami Metropolis that ordered all refuse and slop to "...be carried and thrown into the river ..." In a short time public concern over pollution in the River caused enough of a row that ordinances were drawn up prohibiting the throwing of dead animals, filth or garbage into the River, Bay or any other watercourse (Straight, 1973).

After Henry Flagler's magnificent Royal Palm Hotel opened in January 1897, the Miami River became a lively scene with boats and schooners from around the Florida peninsula and the Bahamas, even though Flagler's newly dredged channel was not deep enough for steamers to cross the Bay and enter the River (Muir, 1953). While development activities were booming on the north side of the River, Brickell Point and the residential area on the "Southside" of the River were only accessible by boat and Brickell's ferry service; except for a short time when an improvised bridge crossed the River at Avenue G (current SW 2 Avenue). There were heated discussions regarding the location of a permanent bridge crossing (Cohen, 1925). William Brickell wanted the bridge built near his home and trading post, but the politically influential Flagler pushed for the Avenue D (current Miami Ave) location, where a bridge with pivoting center span was constructed in 1902 (Peters, 1984).

Residents and tourists enjoyed boat tours up the River's four and one half mile long natural course, to the rapids at the edge of the Everglades. In 1906 Musa Isle Fruit Grove was established near these rapids on the southern bank of the River. This became the last stop on a "jungle cruise." An observation tower provided tourists with grand views of the Everglades. By 1919 visitors were treated to a glimpse of Indian life at Musa Isle Village, where seasonal resident Mikasuki Seminole Indian families displayed crafts and activities in return for food, shelter and small salaries (West, 1981). Coppinger's Tropical Garden, at NW 20 Avenue became another tourist attraction along the River, also employing Seminoles (West, 1981).

Changes on a Grand Scale. While the pristine Everglades and the Miami River were beautiful and magnificent, they presented problems to the area's turn of the century settlers. The Everglades, declared "swamp and overflowed lands" by the State, were considered an impediment to travel and communication, and unfit for human habitation. The River was short and shallow in areas, and not conducive to shipping or commerce. These complaints were certainly not new. Early accounts describing the natural conditions along the southeast Florida coast were often accompanied by references to draining the Everglades and deepening natural rivers and streams.

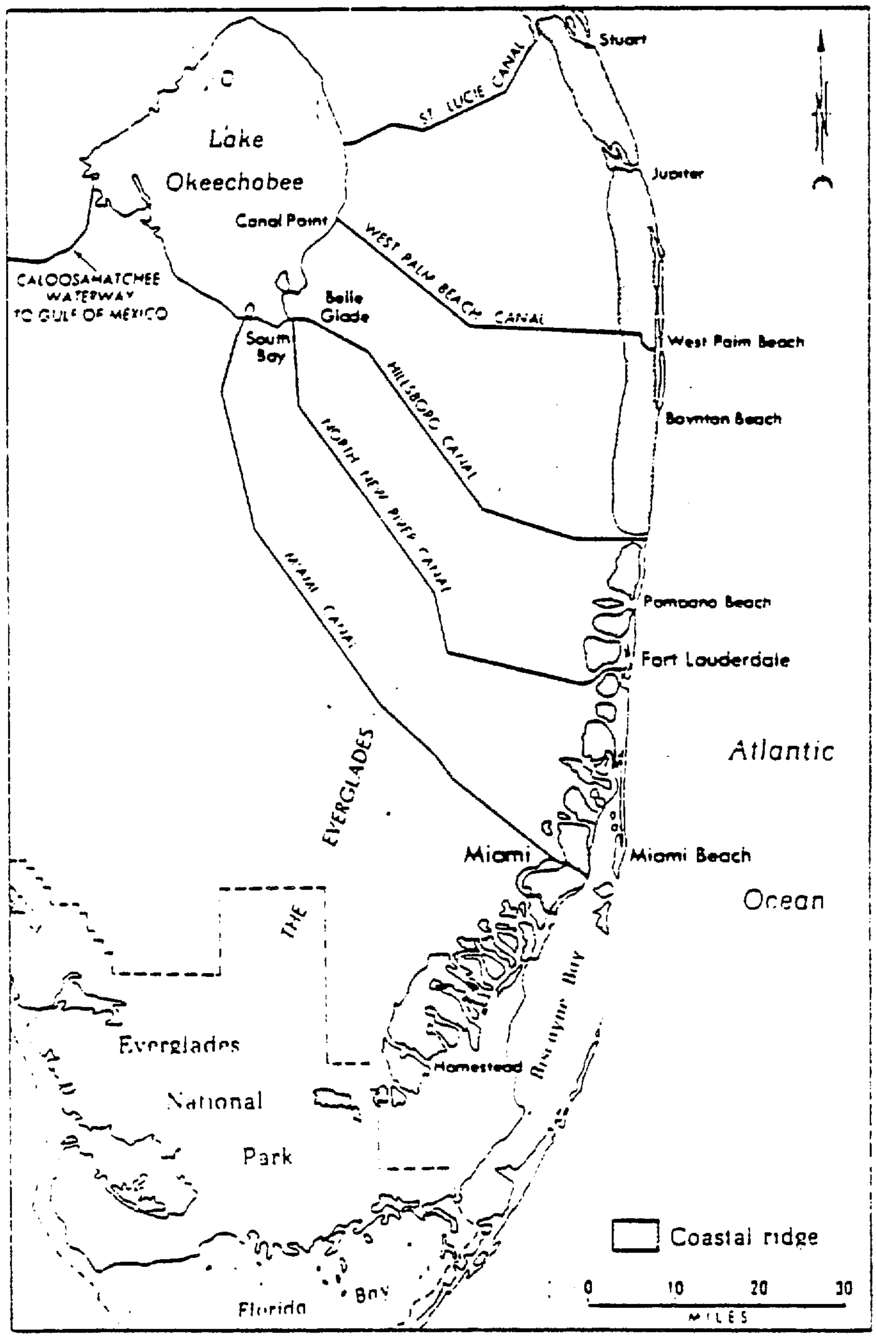
The Everglades Drainage District was established in 1905 as a political subdivision of the State of Florida. Its primary purpose was to reclaim the Everglades for agricultural use. In 1905 the Everglades Drainage District began dredging four waterways from the southeastern shore of Lake Okeechobee to the coast. These included the Hillsboro, West Palm Beach, North New River and the Miami River Canals (Figure 109).

In 1909, as part of the Everglades drainage program, the Miami River Rapids, were dynamited, and muddy waters poured into the once drinkable River water (Muir, 1953), and ultimately into the crystal clear waters of Biscayne Bay (Carter, 1974). While it was no longer advisable to dip in and drink the River water, market-bound boats could pass smoothly from the Bay to interior areas that were being farmed for tomatoes and beans (Muir, 1953).

Between 1907 and 1929 the Everglades Drainage District spent almost $18 million dollars dredging 440 miles of canals and levees (Carter, 1974). From 1909 to 1933 the Miami River was lengthened, dredged and widened to create the eighty-one mile Miami Canal from Lake Okeechobee to Biscayne Bay. While shown as a continuous canal on maps, the upper and lower reaches were isolated by humps in the middle portion which permitted passage of only small amounts of water. This situation was largely corrected in 1983 when the humps were removed. Only the last five and one-half miles of the Miami Canal are navigable due to the presence of a salinity dam west of 36 Street. A temporary sheet metal dam was installed by Dade County in 1945 to stem the tide of salt water intrusion into the County's drinking water wellfields. That structure was replaced by a permanent concrete and steel dam in 1976. At that time the possibility of installing a lock to permit navigation between the Miami Canal and the Miami River was evaluated and found to be economically infeasible.

Starting with the Avenue D (South Miami Avenue) in 1902, fifteen bridges were built across the Miami River (see Table 22). The original Avenue D bridge was replaced in 1919 (Sewell, 1933). In 1909 the only alternative to the Avenue D bridge was the private Tatum bridge at 12th Street (Flagler Street) which could be crossed at a cost of five cents per pedestrian (Peters, 1984). In 1916 the West Flagler bridge opened. The 1920s could almost be considered a decade of River bridges; between 1922 and 1928 the SW 2 Avenue, NW 5 Street, NW 12 Avenue, Brickell Avenue, SW 1 Street, and NW 17 Avenue bridges were completed. In 1938 the NW 27 Avenue bridge opened and in 1966 the NW 22 Avenue bridge began to carry traffic across the river. In 1986 a new six lane bridge was opened at South Miami Avenue.

Public Concern and Action. Concern over environmental degradation, water pollution, bridge openings, and the generally unkempt appearance of the Miami River has been voiced since the 1920s. In 1955 the City of Miami studied the bridges over the River and concluded that "serious consideration should be given and proper steps taken to determine the lowest fixed bridge acceptable for spanning the Miami River." In 1962 with over 30 governmental entities at least partially involved in exercising uncoordinated authority along the River, the Dade County Planning Department



Everglades drainage canals built between 1907 and 1929

FIGURE 109

EVERGLADES DRAINAGE CANALS BUILT BETWEEN 1907 & 1929

SOURCE: SOURCE: CARTER, 1974

TABLE 22

Miami River Bridge Data

Bridge	Type[3]	Clearance[2] Vertical/ Horizontal	Year[1] Build	Year Rebuilt	Age[1] as of 1/85	Average Daily Openings	Comments
Brickell Avenue	Bascule	20'/94'	1928		57	30***	
South Miami Avenue	Bascule		1902	1919 1983-6			First bridge over River
Metrorail	Fixed	75'	1984		1		
SW 2 Avenue	Bascule	11'/75'	1922		63	42*	Out intermittently ly. No truck or bus traffic allowed
I-95	3 Fixed	75'/75'					
SW 1 Street	Bascule	18'/75'	1928		57	24*	
Flagler Street	Bascule	35'/75'	1916	1967	18	16*	
NW 5 Street	Bascule	12'/75'	1925		60	42*	
NW 12 Avenue	Bascule	17'/85'	1927		58	24**	
SR 836	Fixed	75'/75'					
NW 17 Avenue	Bascule	17'/75'	1928		57	22**	
NW 22 Avenue	Bascule	25'/81'	1966		19	12**	
NW 27 Avenue	Bascule	18'/75'	1938		47	12**	
Tamiami Canal	Bascule	6'/35'	1918		67+		Moved from 27 Ave.
S.C.L. R.R.	Bascule	6'/60'					

Notes:

1. Dates and ages were determined from Report on Miami River Study, 1955 and Dade County Road and Bridge Maintenance data, 1978; and Sewell (1933) and Peters (1984).
2. Clearance data obtained from "Miami River Guide and map," The Florida Shipper Magazine, 1984.
3. Dade County operates all bascule bridges, except for Brickell and 27 Avenue, which are operated by Florida DOT).

*Kunde Driver and Associates, October 1983 - September 1984

**Florida Department of Transportation, October 1983 - September 1984.

***Florida Department of Transportation, January - December, 1984.

called for "agreement between all governmental jurisdictions involved on a general pattern for the future development of the waterway"; a zoning plan to create "a desired land use pattern"; additional parks and public open spaces; and improvements to enhance the appearance of the waterway.

In 1971 a River Clean-up committee sponsored by the Greater Miami Chamber of Commerce surveyed and photographed suspected derelict vessels, River bank pollution and outfalls and drainage pipes. A report dated July 22, 1971 stated, "Of the 22 suspected derelicts noted in the March 1971 report, 11 have been removed from the River. An additional 17 suspected derelicts were noted in the June (1971) survey of the River. Many of these are not in violation of present ordinances, but fall into the category of 'eyesores'." With regard to River bank pollution the report noted "The banks of the Miami River continue to be in bad condition -- (with) broken sea walls, trash, junk and other debris." The combined March and June 1971 surveys identified 96 sites which were considered to be sources of River pollution. Forty-five drainpipes and outfalls were investigated as a result of these surveys. As a 1973 Miami Herald article stated: "Thirty-two months after a coalition of federal, state and local agencies decided to save the polluted, junk-strewn Miami River, the Miami River is still polluted and junk strewn. Just not as badly."

On the first weekend of January 1974, just six months before the River would be added to the State aquatic preserve system as part of the Biscayne Bay Aquatic Preserve, hundreds of citizens, school children, park service personnel, flood control engineers and Army Reserve volunteers banded together to rid the River of trash and litter.

The River -- 1974 to 1985. Since the last 5.6 miles of the Miami River were added to the State Aquatic Preserve System in 1974, there have been few notable changes in the appearance of the River or in citizen's perceptions of the River's major problems. An informal survey conducted by the City of Miami Planning Department in 1973 determined that people who lived and worked along the River considered crime and pollution to be the River area's worst problems. In 1984, the Miami River Management Committee (MRMC) created by Governor Bob Graham to develop a master plan for the River, found that crime and pollution were still believed to be the major problems along the River banks.

This study has been coordinated with the work of the MRMC and its successor, the Miami River Coordinating Committee (MRCC) as closely as possible. Much of the material that follows was reviewed by the MRCC and used in formulating its December 1985 recommendations.

THE MIAMI RIVER - 1984/85

The bridges and expressway overpasses which connect the north and south banks of the River divide this water body into distinct districts or basins. Therefore, the following descriptions of shoreline usage are divided into five sections: the mouth of the River to I-95, I-95 to the 5th Street Bridge, the 5th Street Bridge to the 17th Avenue Bridge, the 17th Avenue Bridge to the 27th Avenue Bridge and the 27th Avenue Bridge to the salinity dam.

Basin A -- Mouth of the River to I-95

The River channel from the mouth to I-95 is approximately nine tenths of a mile in length. The channel ranges from 164' wide just east of I-95 to 218' wide east of Miami Avenue and just east of Metrorail (see Figure 114). The depth of the channel in this basin ranges from 15.5' at mean low tide east of I-95 to 18.2' (ml) at the mouth.

Figure 110 shows the shoreline characteristics of this basin. More than 90 percent of the total nine thousand plus feet of River shoreline is vertically bulkheaded, five percent is unconsolidated and two percent riprapped. About 80 percent of the shoreline in this area is in relatively good condition. However, the sheet steel bulkhead adjacent to the IntraAmerican Investment property on the southeast side of the Miami Avenue Bridge is badly deteriorated as is the bulkhead west of SW 2 Avenue and North River Drive. Major shoreline repairs are also needed in the area southwest of the Miami Avenue Bridge and west of Dawson's Marina at French Benzol Cleaners, and in the Metrorail right-of-way.

In 1973-4, 36 percent of the Riverfront in Basin A was devoted to marine uses. By 1984 the length of River frontage in marine uses had declined to 32 percent. The amount of vacant Riverfront land also decreased while the amount of land in public park and right-of-way and non-marine commercial uses increased. These changes are shown on Figure 111, and summarized in Table 13.

In 1984-5 the River area in Basin A was characterized by the Hyatt/Knight Hotel Convention Center Complex, Metrorail, and several large, underutilized parcels. The 1985 Riverfront land uses are shown in Figure 112. Located between the rapidly developing Brickell Area and Downtown Miami, this area has more vacant land than any other area of the River within the Preserve.

According to Metro-Dade Office of Management and Budget (1985) the total assessed value of property in Basin Area A in 1984, was almost $99 million. The total assessment grew by almost $40 million from 1980 to 1984. The redevelopment potential of the area is reflected in coastal construction permitting activities which resulted in over three million dollars of improvements during the 1980-1984 period. These included a seawall at the Miami Center and Ft. Dallas Park, bulkheading and filling at the Miami Shipyards and construction of the Miami Avenue Bridge (Figure 113).

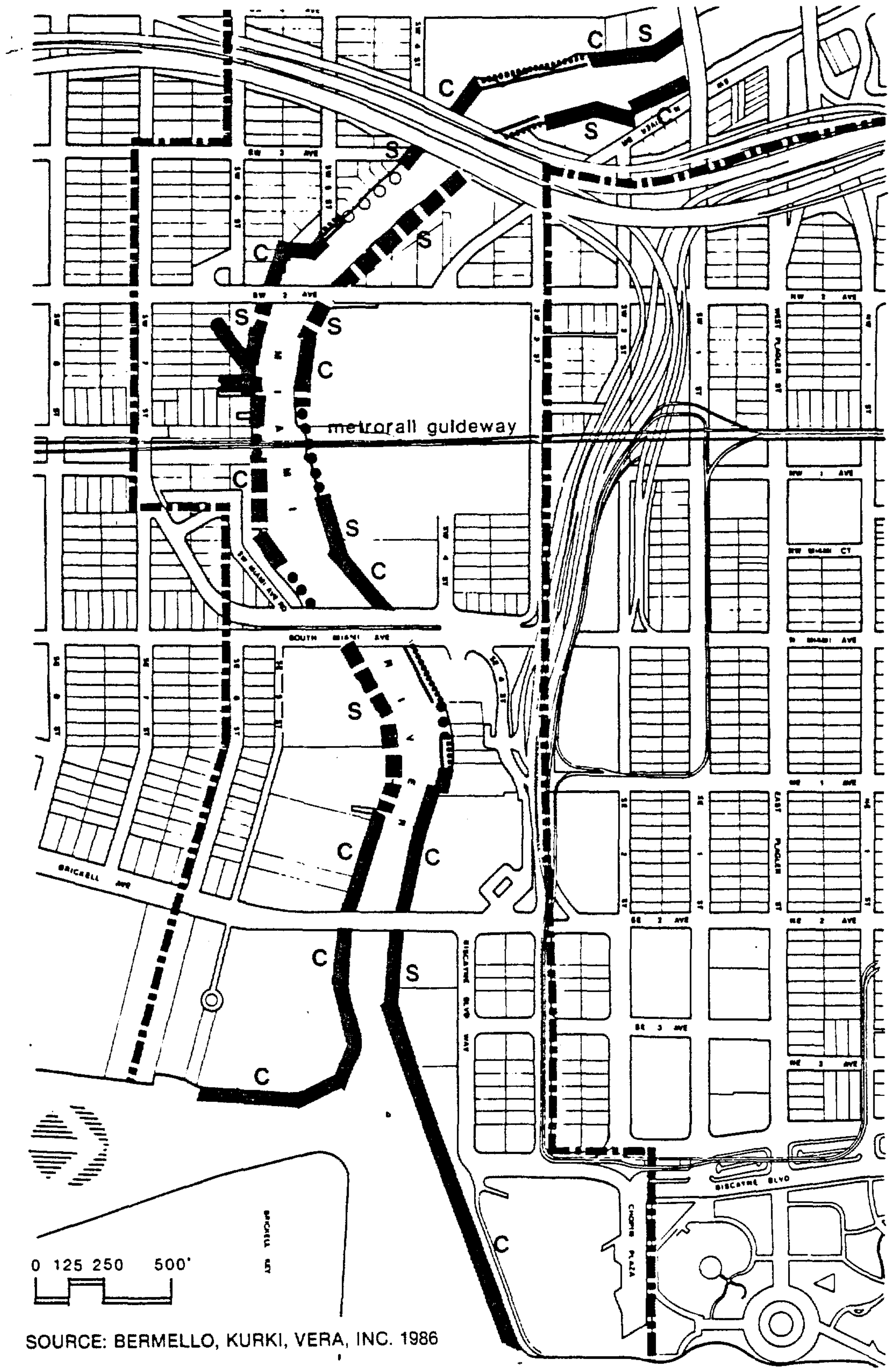


FIGURE 110

RIVER EDGE CONDITIONS—BASIN A—MOUTH OF RIVER TO I-95

- STABILIZED/GOOD CONDITIONS
- STABILIZED/IN NEED OF REPAIR
- NATURAL LIMEROCK
- RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
- UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
- C CONCRETE BULKHEAD
- S STEEL BULKHEAD
- W WOOD BULKHEAD
- ooooo DOCKS

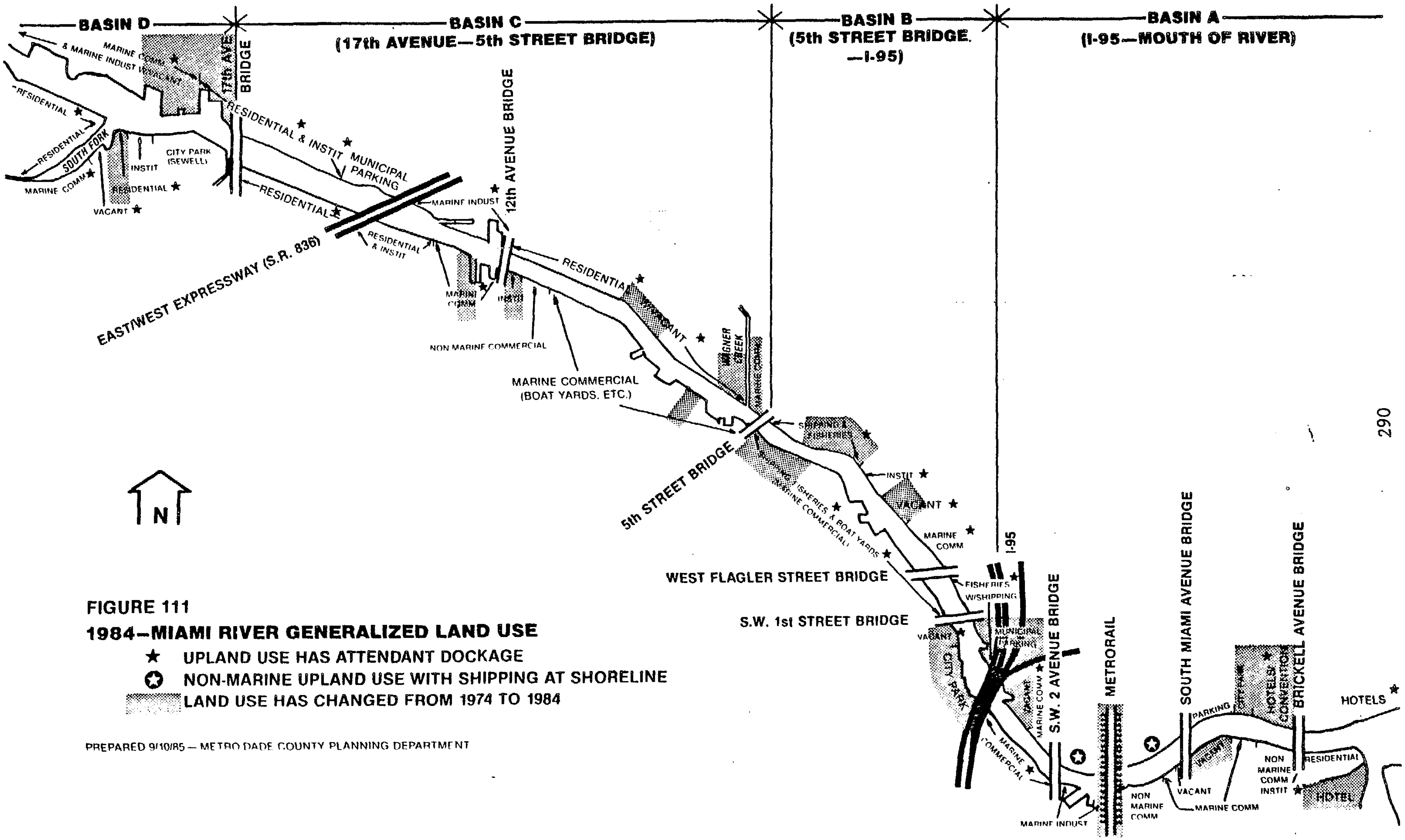
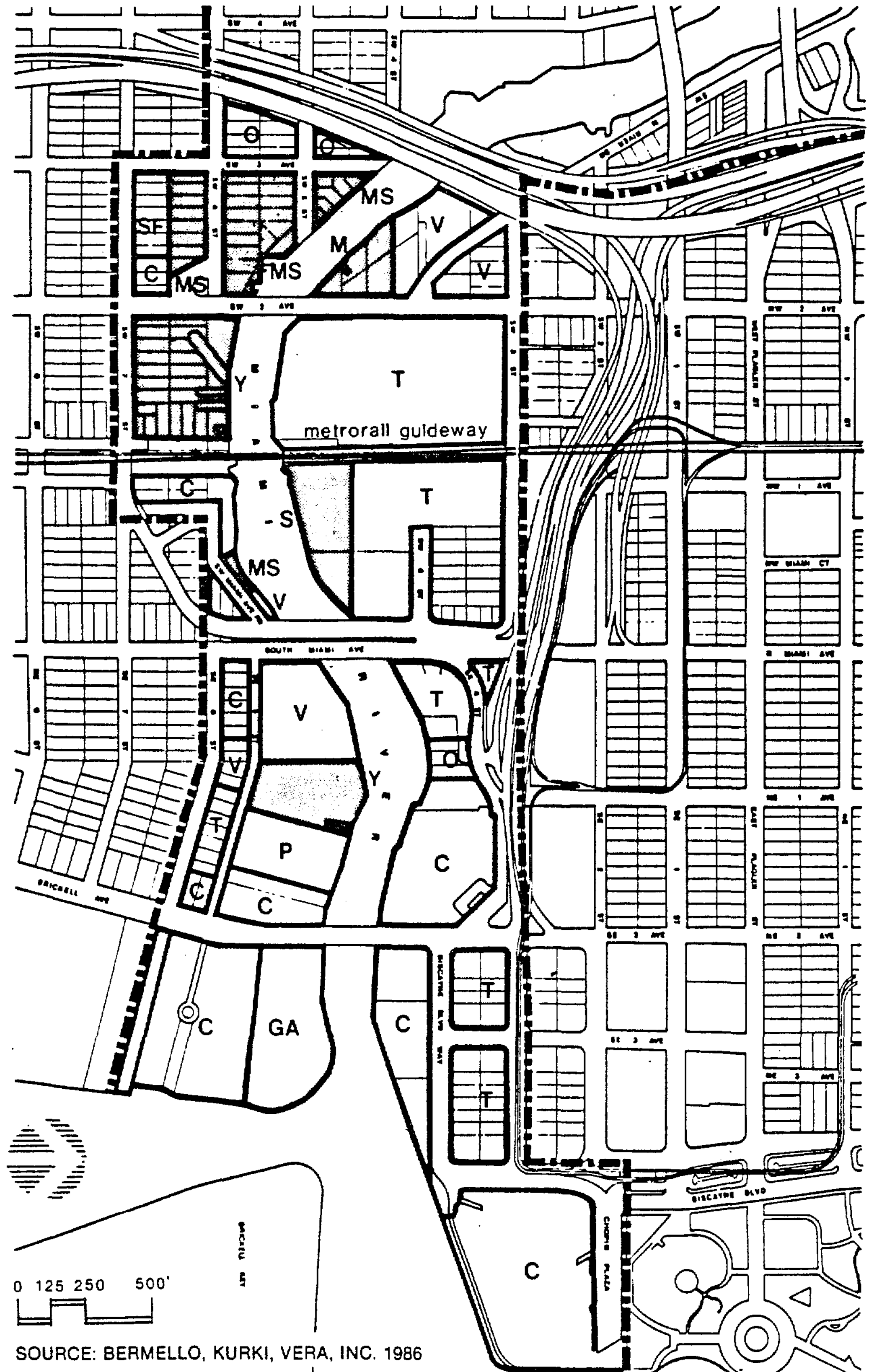


FIGURE 111

1984–MIAMI RIVER GENERALIZED LAND USE

- ★ UPLAND USE HAS ATTENDANT DOCKAGE
- ✪ NON-MARINE UPLAND USE WITH SHIPPING AT SHORELINE
- LAND USE HAS CHANGED FROM 1974 TO 1984

PREPARED 9/10/85 — METRO DADE COUNTY PLANNING DEPARTMENT



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 112

LAND USE—BASIN A—MOUTH OF RIVER TO I-95

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT

O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

FIGURE 113

1980-85 COASTAL CONSTRUCTION

SOURCES: METRO-DADE DERM FILES &
METRO-DADE PLANNING DEPT., 1985

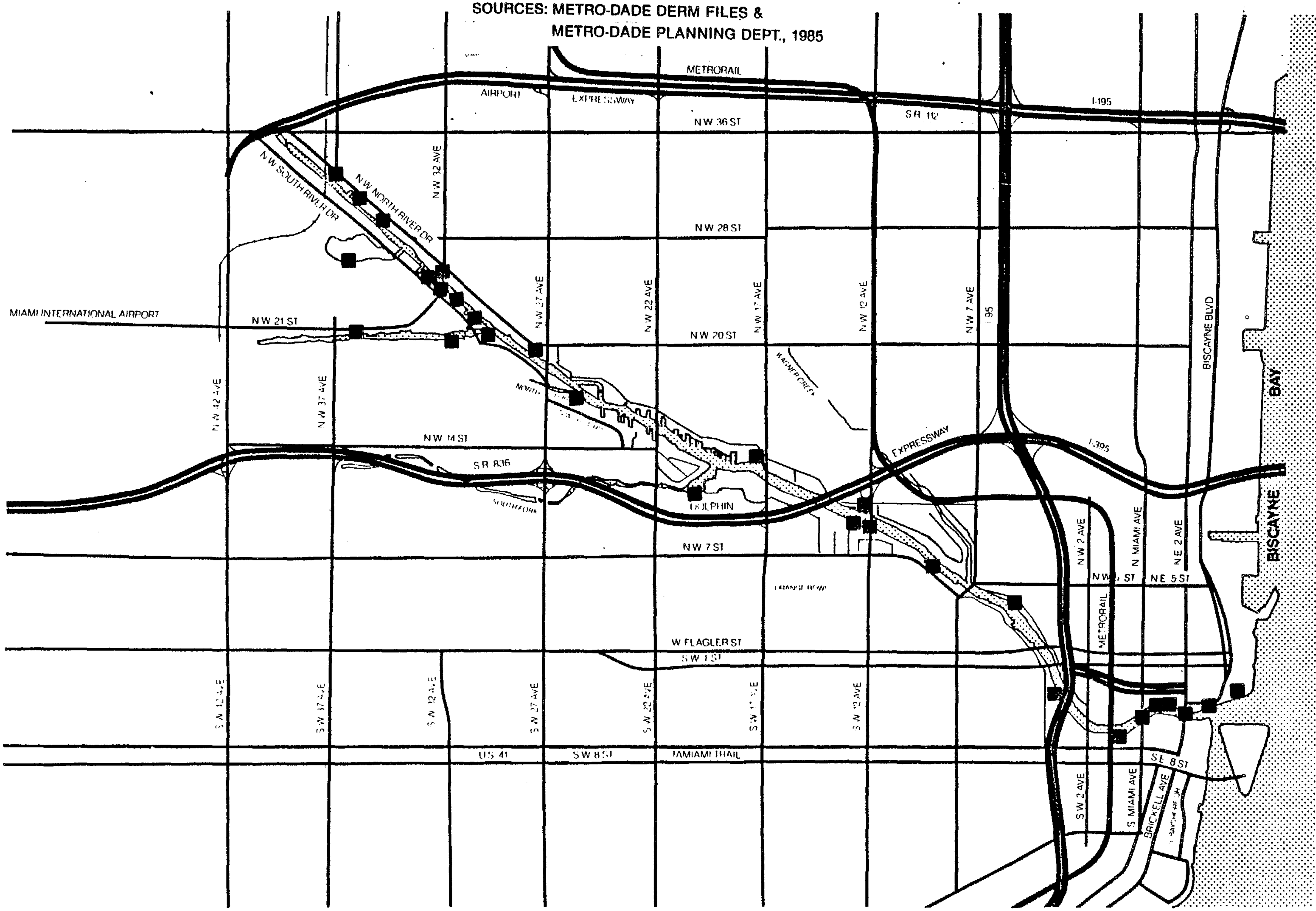
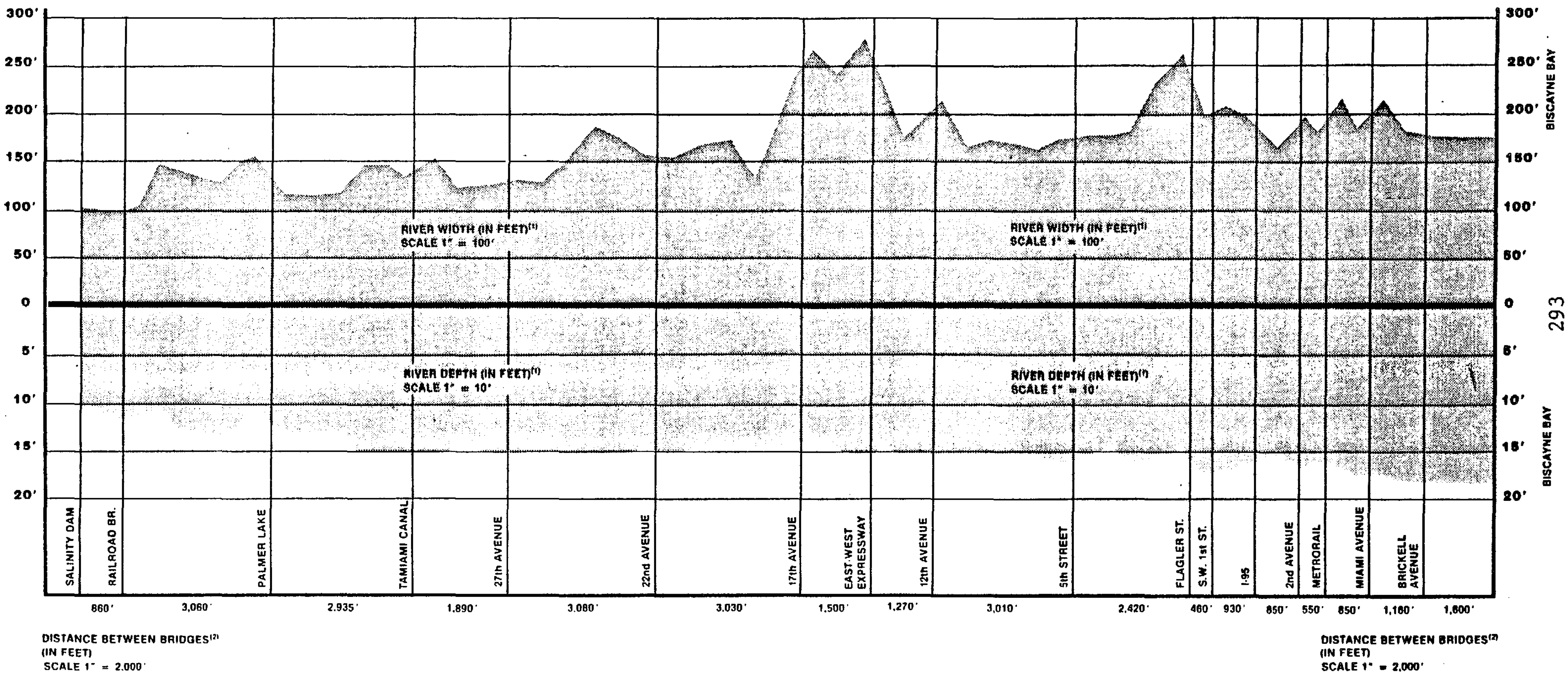


FIGURE 114

MIAMI RIVER LENGTH, WIDTH & DEPTH



NOTES
(1) SOURCE US ARMY CORPS OF ENGINEERS CROSS SECTION

(2) SOURCE MODIFIED FROM CITY OF MIAMI PLANNING DEPT 1974 (INFO BOOKLET NUMBER 3)

NOTES
(1) SOURCE US ARMY CORPS OF ENGINEERS CROSS SECTION

(2) SOURCE MODIFIED FROM CITY OF MIAMI PLANNING DEPT 1974 (INFO BOOKLET NUMBER 3)

TABLE 23

1974-1984 Land Use Changes
Basin A - Mouth to I-95

	1974	1984	Net '74-'84 Change
Vacant/Parking	2,753'	2,375'	-378'
Public Park/R-o-W	683'	862'	+179' Metrorail Right of Way plus 700' Riverwalk
Residential	450'	450'	no change
Marine Commercial/Industrial	3,332'	2,932'	-400'
Non-Marine Commercial/Industrial	1,904'	2,428'	+524' Hyatt/Knight Center; River Parc Hotel
Government/Istitutional	150'	225'	+75' U.S. Customs/ Treasury
Total Linear Frontage, North and South Banks Combined	9,272'	9,272'	

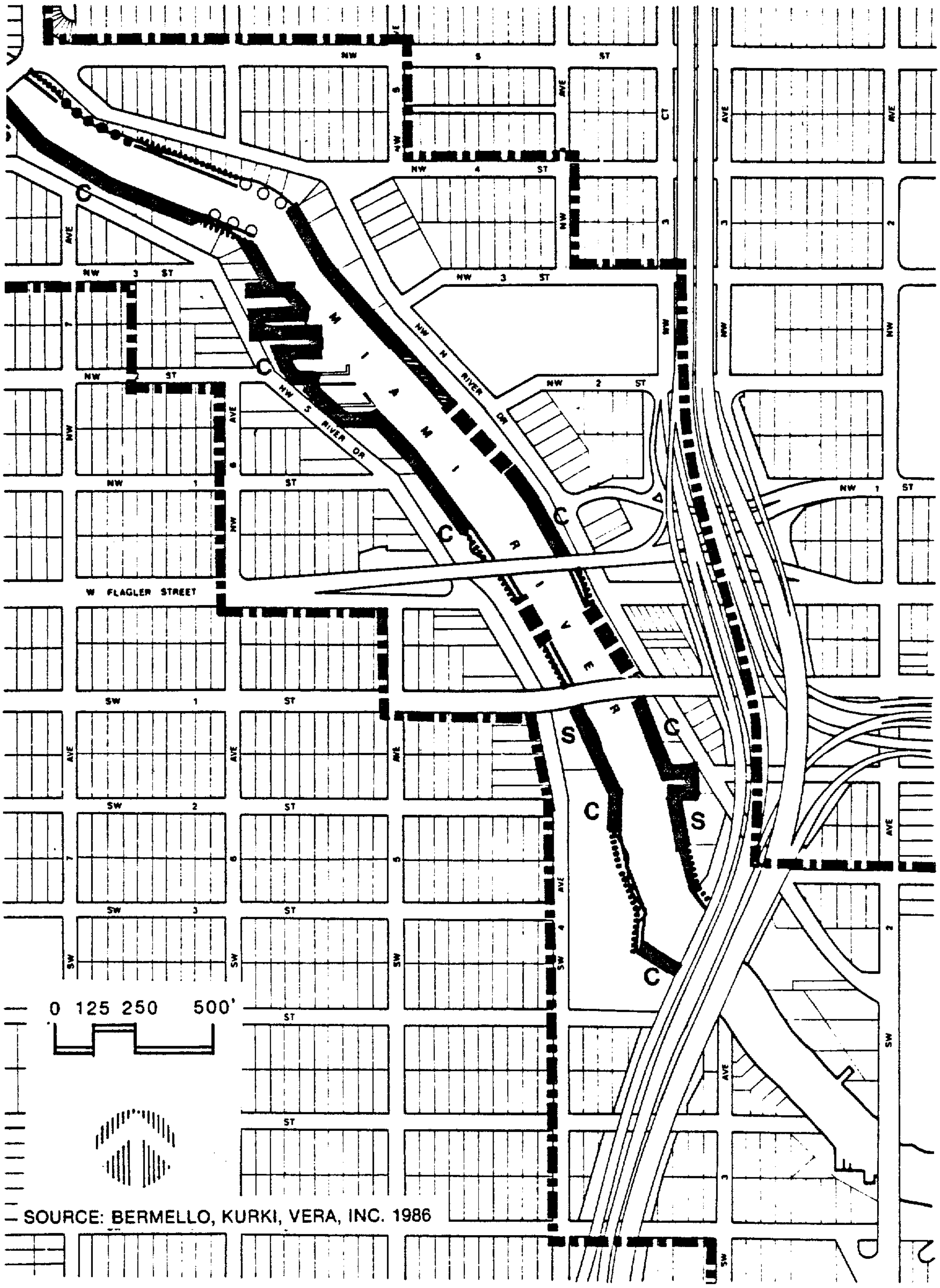
There are approximately 16 storm water outfalls that discharge into Basin A. In addition, there are five electric cable crossings, and a telephone cable crossing.

Bssin B -- I-95 to 5th Street Bridge

The River basin from I-95 to 5th Street is slightly more than three quarters of a mile in length. This area is further subdivided by the First Street and Flagler bridges. Just east of the 5th Street Bridge, the River narrows to 180'. Depths range from 17.5 feet between the First and Flagler Street bridges to 14.7 feet near the 5th Street Bridge. Average River depth in Basin B is 16.1' (Figure 114).

Figure 115 depicts the shoreline characteristics of Basin B. Eighty-five percent of the north bank and 72 percent of the south bank is vertically bulkheaded. Twenty percent of the shoreline is in poor, eroding condition. Immediately south of Lummus Park, and on both sides of the River between Flagler and SW 1 Street there are bulkheads which need major repair or replacement.

This area has a larger percentage of riprapped shoreline than any other region of the River and is one of the few areas where the shoreline length has increased during the past decade. Both the increase in shoreline length and the relatively high percentage of riprapped shore are the result of development of Jose Marti Park. The riprap areas are in need of maintenance and minor repairs.



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 115

RIVER EDGE CONDITIONS—BASIN B—I-95 TO 5th STREET BRIDGE

- STABILIZED/GOOD CONDITIONS
- STABILIZED/IN NEED OF REPAIR
- NATURAL LIMEROCK
- RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
- ••••••• UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
- C CONCRETE BULKHEAD
- S STEEL BULKHEAD
- W WOOD BULKHEAD
- ooooo DOCKS

Both banks of the River in Basin B are served with sanitary and storm water sewer systems. There are approximately 16 storm sewer outfalls that discharge into this portion of the River. The pump station at NW 4 Street has an emergency overflow that discharges combined storm water and sewage during heavy rainstorms.

In contrast to the transitional urban core/vacant appearance of Basin A, the area west of I-95 has remained in low rise fishing and commercial uses juxtaposed with institutional uses and a few older residences (Figure 116). Over 60 percent of the Riverfront in Basin B is devoted to marine uses. In February 1986 there were 135 boats less than 100 feet in length docked at four marinas and along bulkheads in this unit. Wholesale fisheries such as National, East Coast and Florida Carib Fishery; seafood restaurants such as East Coast and Joe's restaurant; Colpac Shipping, Denizana Shipping, Bahamas International Shipping and other marine related companies give this basin a distinctive marine commercial character. The open storage of lobster traps, boats full of open non-containerized cargo on its way to Haiti, the flotilla of "sponge fishing boats" just north and south of the Flagler bridge, and the congregation of pelicans around Joe's Restaurant/Fish Market and National Fisheries add to the marine image of this area.

Unfortunately, this stretch of the River is surrounded by the high crime areas of East Little Havana and Overtown. The City of Miami Police responded to 51 incidents on North and South River Drive during the first three months of 1986. The majority of the incidents involved larceny, stolen property, assault and burglary.

Approximately 35 percent of the shoreline is publicly owned park land, public right-of-ways or governmental operations. The Jose Marti Riverfront Park, located just west of I-95 on the south bank of the River, has over 660 feet of shoreline with river walk and boat ramp. A second important, but underutilized open space is Lummus Park on the north bank of the River between NW 2 and 3 Streets.

In 1985, as in 1974, street patterns severely limit the depth of Riverside lots thereby constraining shoreline development or redevelopment. Table 24 summarizes the changes that occurred in shoreline uses during the 1974-84 decade in Basin B. These changes are also depicted graphically in Figure 111.

According to the Metro-Dade Office of Management and Budget (1985), the total assessed property values in 1984 for River Area B was $5.9 million. Sixteen percent, or just under one million was tax exempt in either County or City ownership. Total assessed growth for the area from 1980-84 was just over $1.5 million. Many parcels in this basin are rental properties, particularly on the south bank west of Flagler Street.

From 1980 through 1985 ten coastal construction permits were applied for in Basin Area B, but only three projects were carried out (see Figure 113). The City of Miami bulkheaded, filled and placed riprap and terrafix revetment along the shoreline of Jose Marti Park in 1984. In sum only about $200,000 in coastal improvements were made in this area between 1980 and 1985.

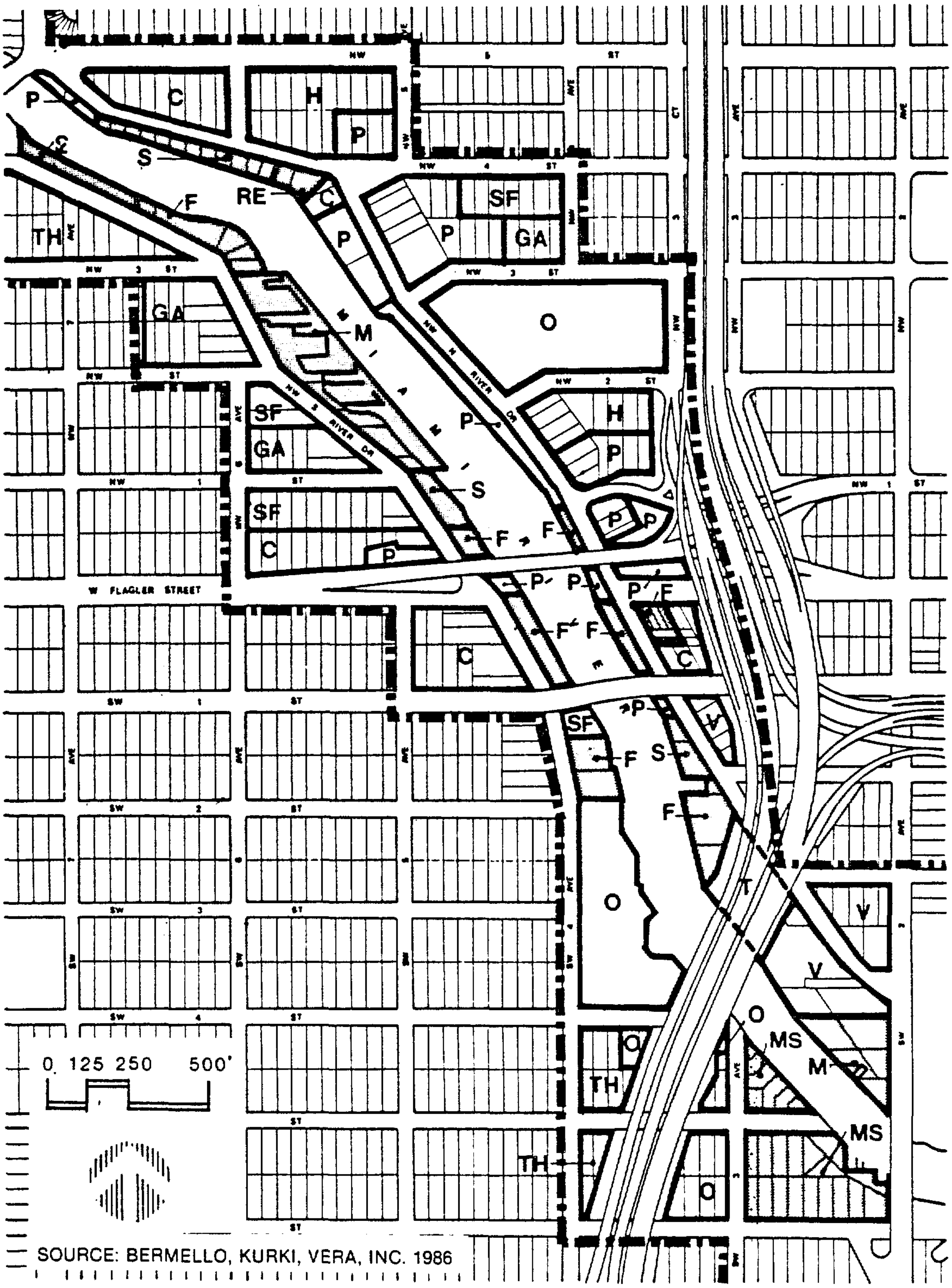


FIGURE 116

LAND USE—BASIN B—I-95 TO 5th STREET BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT
O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

TABLE 24

1974-1984 Land Use Changes
Basin B - I-95 to 5th Street Bridge

	1974	1984	Net '74-'84 Change
Vacant/Parking	917'	350'	-567'
Public Park/R-o-W	1,287'	1,887'	+660 Jose Marti Park
Residential	425'	75'	-350'
Marine Commercial/Industrial	4,680'	4,997'	+337' Haitian vessel moorage; sponge and fish trap storage
Non-Marine Commercial/Industrial	40'	40'	no change
Government/Institutional	865'	965'	+100' Metro-Dade Work Yard
Total Linear Frontage, North and South Banks Combined	8,214'	8,314'	+100 increase in shoreline at Jose Marti Park

Basin C -- 5th Street Bridge to 17th Avenue Bridge

The River channel extends almost 6,000' from the 5th Street to the 17th Avenue bridges. The River ranges from 165' wide just west of Wagner Creek to the widest point in the entire River channel of 280' just west of the East/West Expressway. Depths in Basin C range from 13.8 to 16.4 feet at mean low water (see Figure 114).

Between 5 Street and 17 Avenue 89 percent of the north bank and 80 percent of the south bank is vertically bulkheaded. From the 5th Street Bridge to the 12th Avenue Bridge approximately 80 percent of the River's edge is bulkheaded, and mostly in good condition. Approximately 15 percent of the shoreline has been riprapped. Aside from the Metro-Dade property southeast of the 12th Avenue Bridge, all of the other unconsolidated shorelines abut vacant or abandoned properties. These are unsightly and need major maintenance or bulkheading (Figure 117).

Between 12 Avenue and 17 Avenue approximately 75 percent of the River's edge is bulkheaded and in very good condition. An additional 22 percent of the shoreline is unconsolidated. The shoreline at Robert King High Towers and along the East-West Expressway right-of-way is unconsolidated and eroding. There is a very small amount of riprap immediately to the west of the Merrill Stevens boat yard on the north bank (Figure 118).

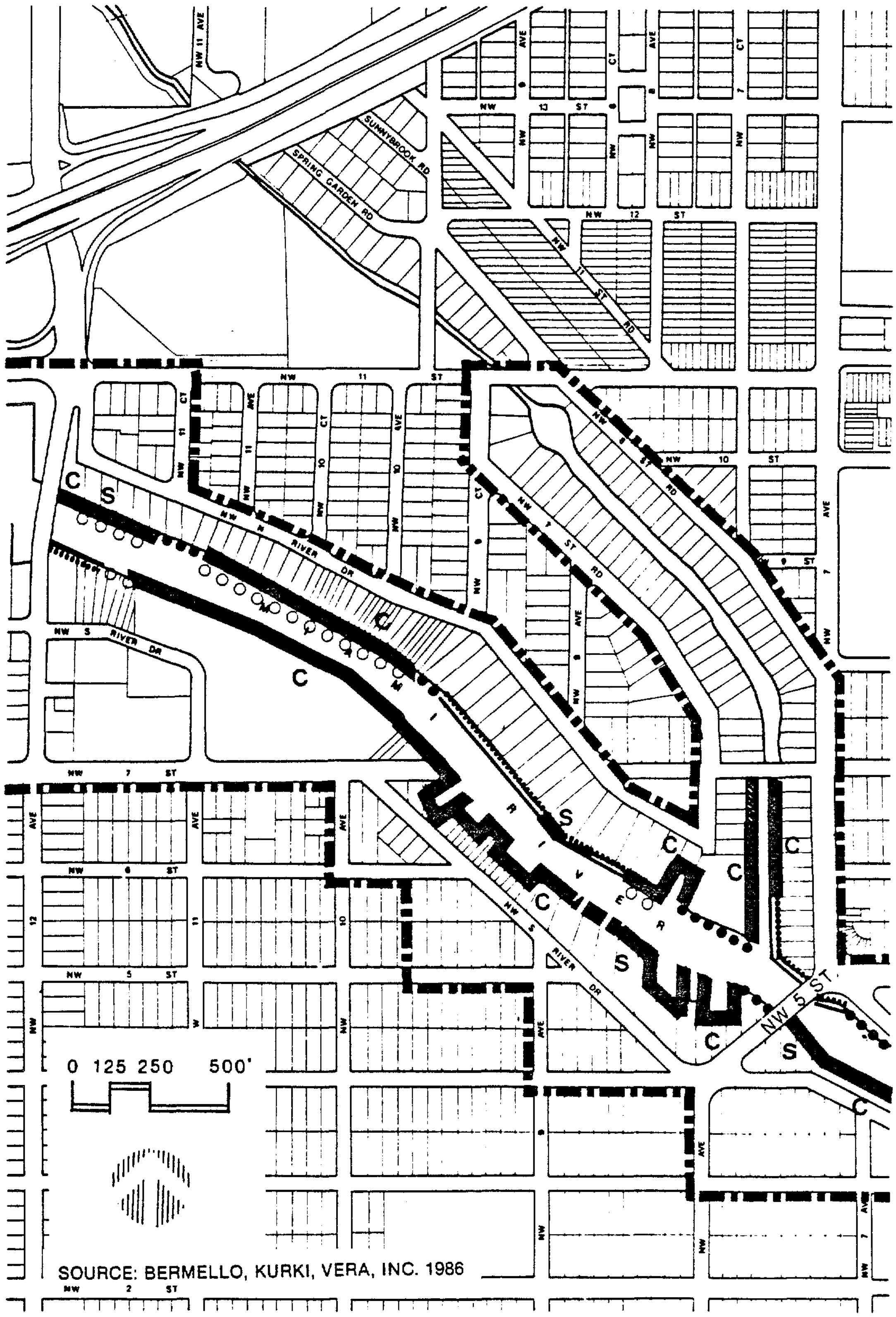


FIGURE 117

RIVER EDGE CONDITIONS—BASIN C—5th STREET TO 12th AVENUE BRIDGE

- STABILIZED/GOOD CONDITIONS
- STABILIZED/IN NEED OF REPAIR
- NATURAL LIMEROCK
- RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
- UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
- C CONCRETE BULKHEAD
- S STEEL BULKHEAD
- W WOOD BULKHEAD
- ooooo DOCKS

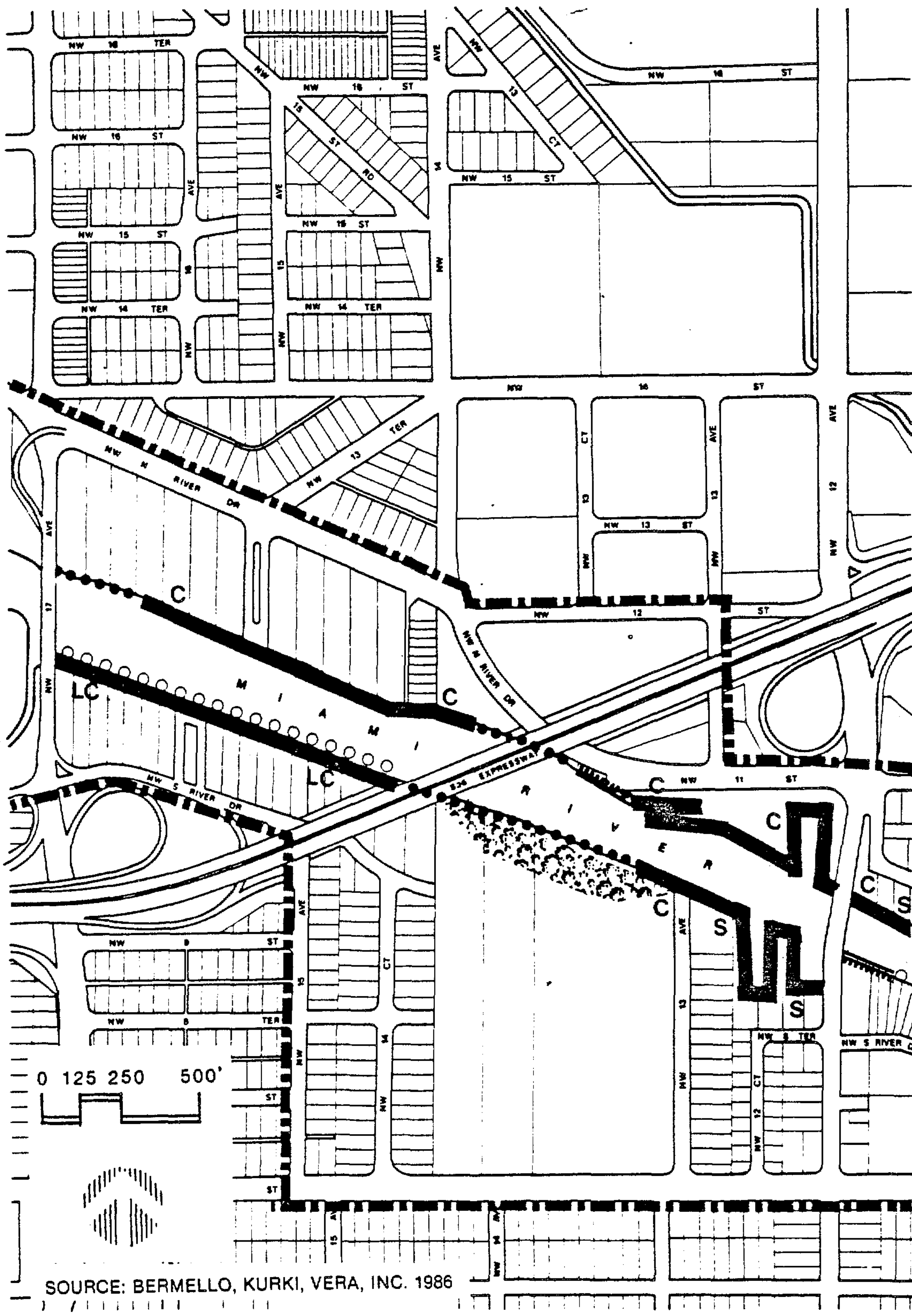


FIGURE 118

RIVER EDGE CONDITIONS—BASIN C—12th AVENUE TO 17th AVENUE BRIDGE

STABILIZED/GOOD CONDITIONS
STABILIZED/IN NEED OF REPAIR
NATURAL LIMEROCK
RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
C CONCRETE BULKHEAD
S STEEL BULKHEAD
W WOOD BULKHEAD
DOCKS

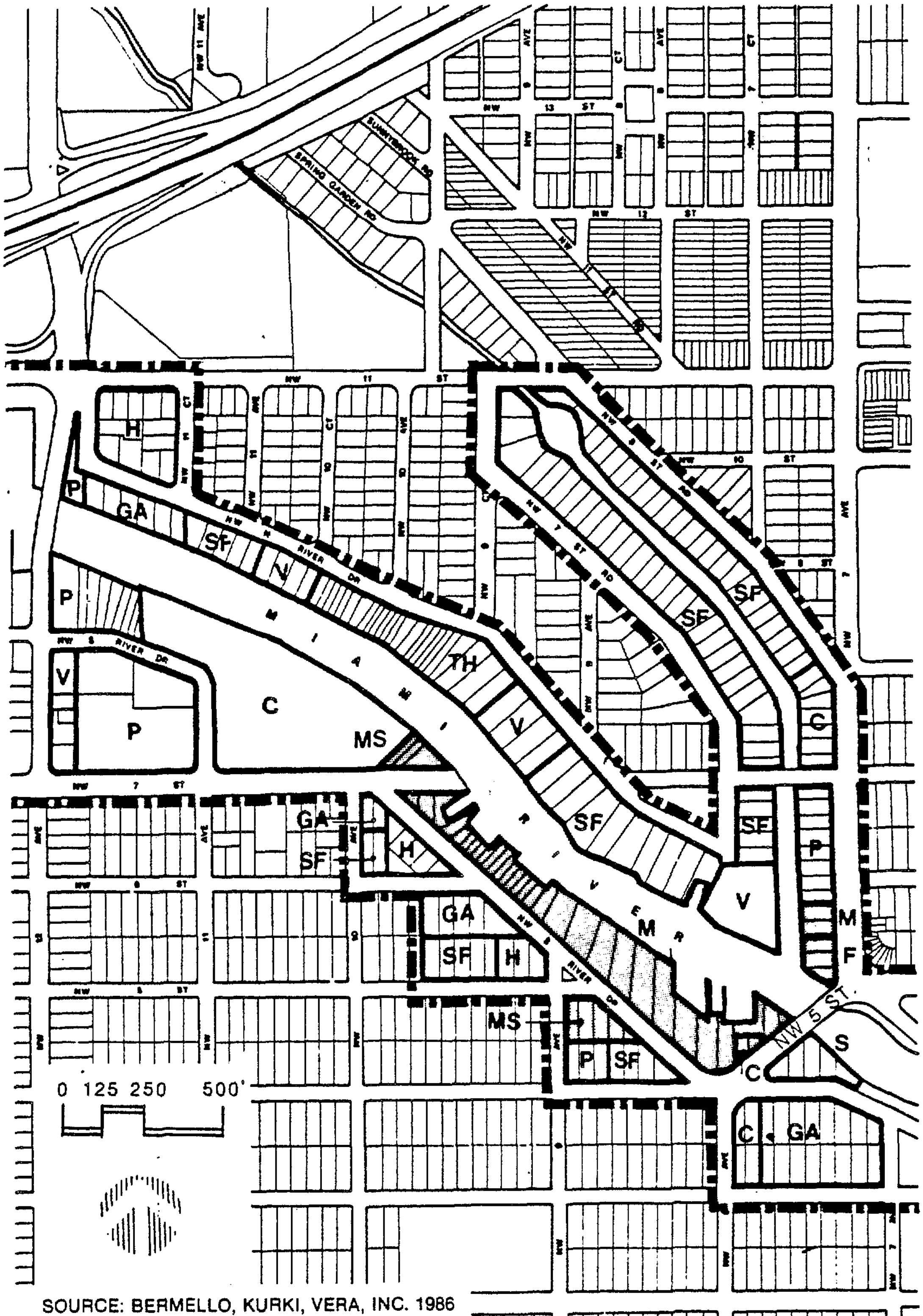
The eastern half of this basin between the 5th and 12th Avenue bridges, is divided into three different land use areas. Approximately 25 percent of this area is devoted to marine related uses, 40 percent is residential, 15 percent is nonmarine, 15 percent is vacant and five percent is publicly owned (Figure 119). Marine related uses including Eighth Avenue Boat Slips, Norseman, Florida Marine Center, River Port and Anchor Marine are located on the south bank between 5 Street and the old Miami News building at 11 Avenue, which is now owned and operated by Southeast Bank as a back office. In February 1986 there were approximately 140 vessels less than 100 feet in length docked at these marine facilities and along bulkheads in this part of Basin C. Immediately to the west of the old News building, Metro-Dade County operates a service yard. Outside of the marine patrol office dock, the County facility is nonmarine related. The north bank is characterized by single family residences, townhouses and apartments.

Properties in the eastern half of Basin C are generally in good condition, however, a few vacant parcels along the north bank and the Metro-Dade property just east of the 12th Avenue Bridge need maintenance and shoreline stabilization. The worst conditions are found along the Seybold Canal, just outside the APMA where deteriorating bulkheads, trash piles, sunken or derelict vessels and sources of pollution are abundant. A number of uses along NW 7 Avenue such as Southern Bell parking lot, auto repair and body repair shops are nonmarine related and incompatible with the single family district to the west.

To the west of 12 Avenue, the Riverfront is primarily institutional and residential in character. The most prominent features are the Robert King High Towers, the Mahi Temple and other Masonic lodges, the 836 expressway crossing, and the Merrill Stevens Boat Yard. In this section of Basin C, approximately 40 percent of the shoreline is devoted to public right-of-way and institutional uses, 45 percent of the shoreline is devoted to residential uses, but only 15 percent is used for marine related activities (Figure 120). In February 1986 there were approximately 55 vessels docked at Merrill Stevens Repair Yard and along the south bank in the area west of the Expressway. With the exception of a few single family residences and houseboats immediately west of the expressway right-of-way on the south bank, this stretch of the River is in very good condition.

The area between 5 Street and 17 Avenue remained almost completely unchanged during the decade from 1974-84 (Table 25). The only physical change of note was the development of townhouses on a formerly vacant parcel on the north bank in the vicinity of NW 10 Street (see Figure 111). However, several of the parcels on the north bank are not owner occupied, indicating that this area may undergo redevelopment within the next few years.

The total assessed value of shoreline property in Basin C increased 21 percent from 1980 to 1984. However, 46 percent of the total assessed 1984 valuation of $59,222,010 was tax exempt in the ownership of the City of Miami, Dade County and several nonprofit organizations.



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 119

LAND USE—BASIN C—5th STREET TO 12th AVENUE BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT
O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

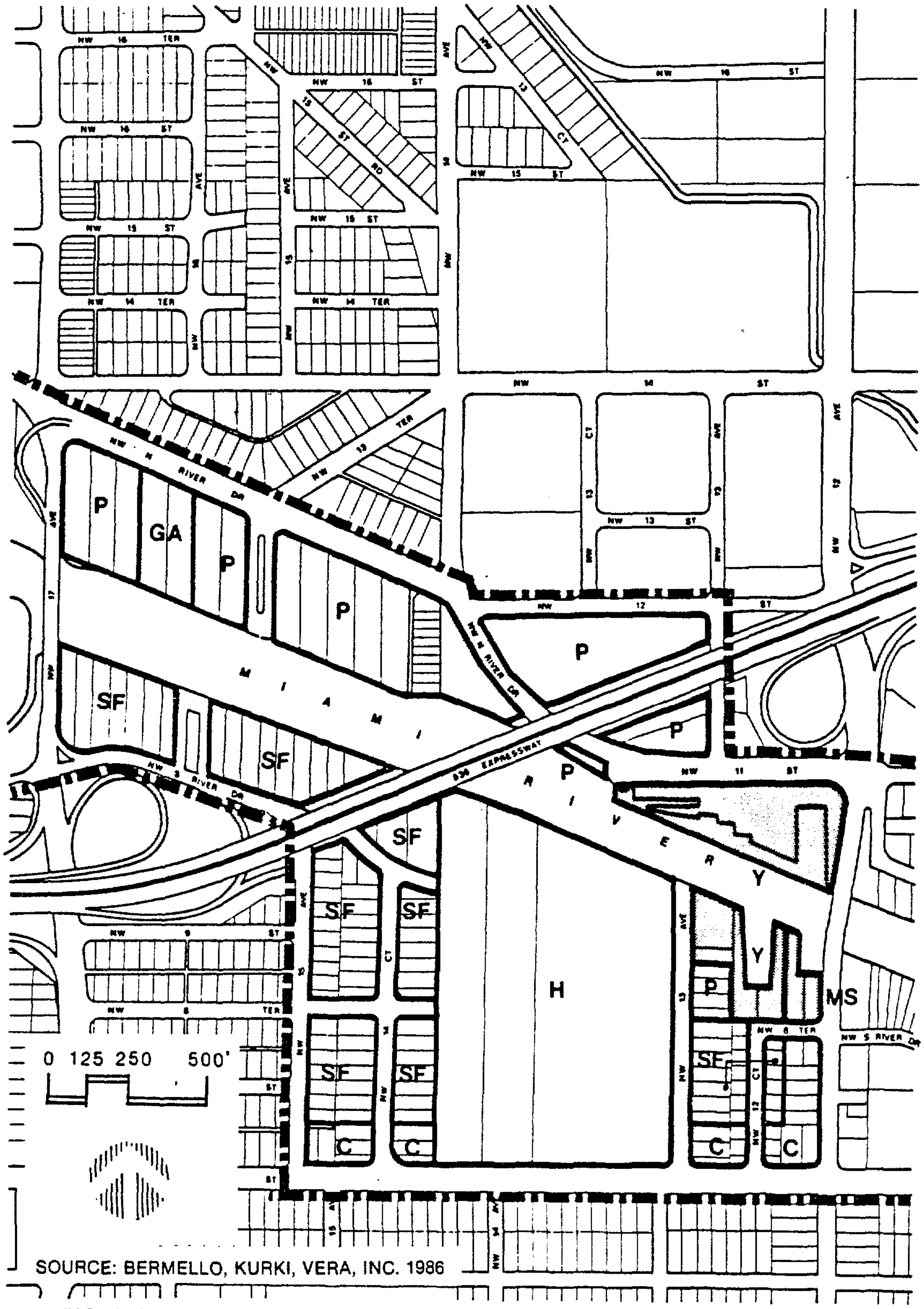


FIGURE 120

LAND USE—BASIN C—12th AVENUE TO 17th AVENUE BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT

O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

With the exception of a small private dock, all of the coastal construction activity in Basin C took place at the Merrill Stevens Yard or at Backus Towing Company (see Figure 113). Almost $250,000 in shoreline improvements were made at those two locations during the 1980-85 period.

Both banks of the River in Basin C are served with sanitary and storm sewer systems. There are approximately ten storm water outflows that discharge into Basin C.

TABLE 25

1974-84 Land Use Changes
Basin C - 5th Street Bridge to 17th Avenue Bridge

	1974	1984	Net '74-'84 Change
Vacant/Parking	1,715'	765'	-950'
Public Park/R-o-W	1,325'	1,325'	no change
Residential	2,875'	3,775'	+900' townhouses
Marine Commercial/Industrial	4,780'	4,830'	+50' (650' for sale/ 1985)
Non-Marine Commercial/Industrial	900'	1,000'	+100'
Government/Institutional	2,300'	2,200'	-100 (200' for sale 1984-5)
Total Linear Frontage, North and South Banks Combined	13,895'	13,895'	

Basin D -- 17th Avenue to 27th Avenue

Basin D is characterized by residential, park, marina and boat yard uses. This area presents a study in contrasts with extremely attractive shoreline areas in close proximity to poorly maintained, trash laden facilities.

Approximately 50 percent of the River's edge in the eastern half of Basin D is devoted to marine related uses such as Hardie's Marina, Nuta's Boatyard and Poland's Marina. Along the South Fork the most dominant feature is Allied Marine. In February 1986 there were approximately 300 vessels less than 100 feet in length docked at seven marine facilities and along the banks of the River and South Fork in this Basin. About 35 percent of the shoreline is devoted to single family, townhouse and high rise residential uses. Sewell Park and Dodge Mental Health Hospital, immediately to the west of the park (Figure 121), make up the balance of the shoreline.

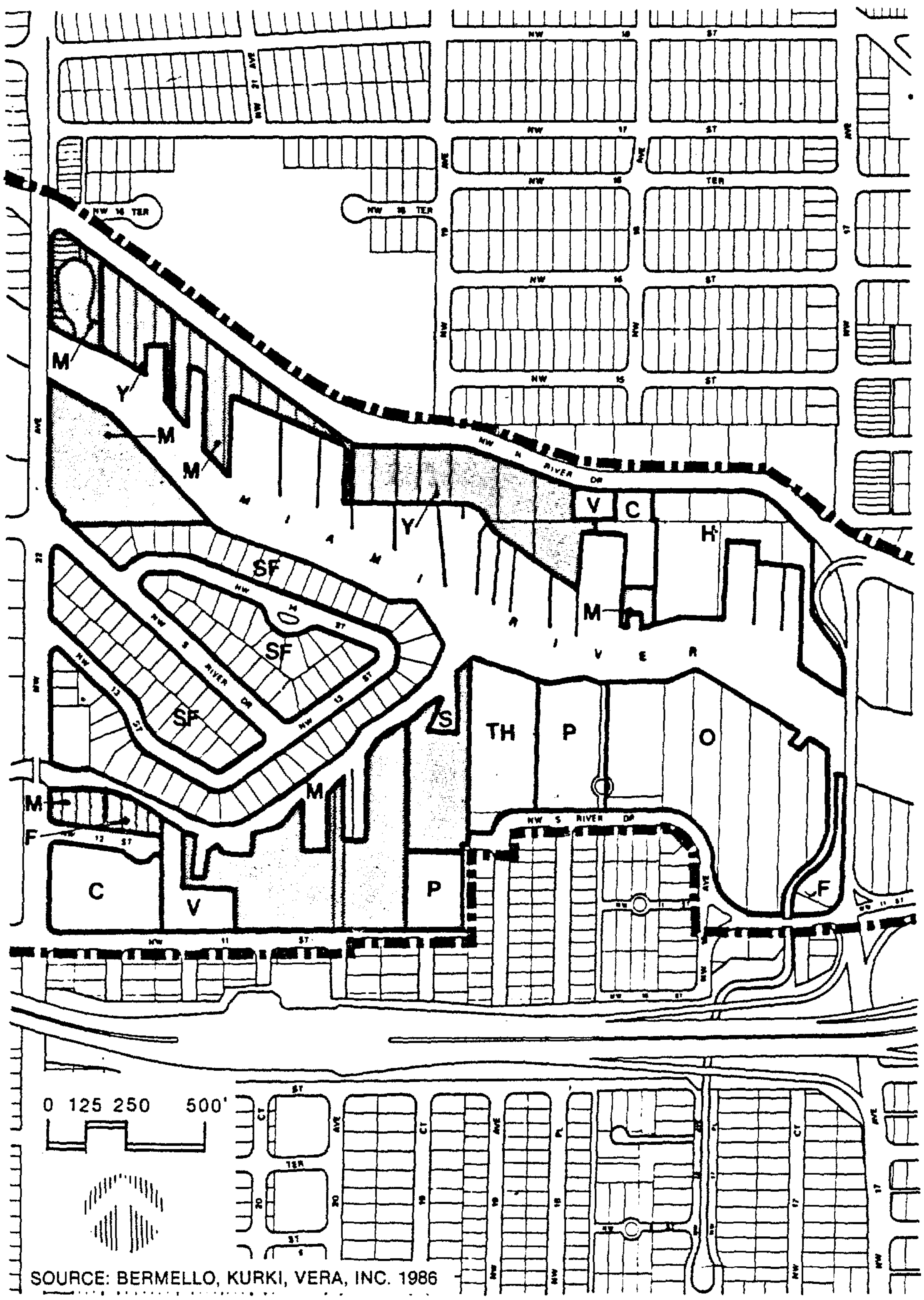


FIGURE 121

LAND USE—BASIN D—17th AVENUE TO 22nd AVENUE BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT

O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

The area west of the 22nd Avenue Bridge is primarily residential in character with approximately 60 percent of the shoreline devoted to residential uses. Marine related uses comprise only 20 percent of the shoreline. Another 10 percent of the shoreline consists of non-marine commercial and public/institutional uses. The balance of the shoreline consists of vacant parcels and Gerry Curtis Park (Figure 122). In February 1986 there were approximately 120 vessels docked at Florida Yacht Basin, at Isla del Mar and along the banks of the River and the North Fork.

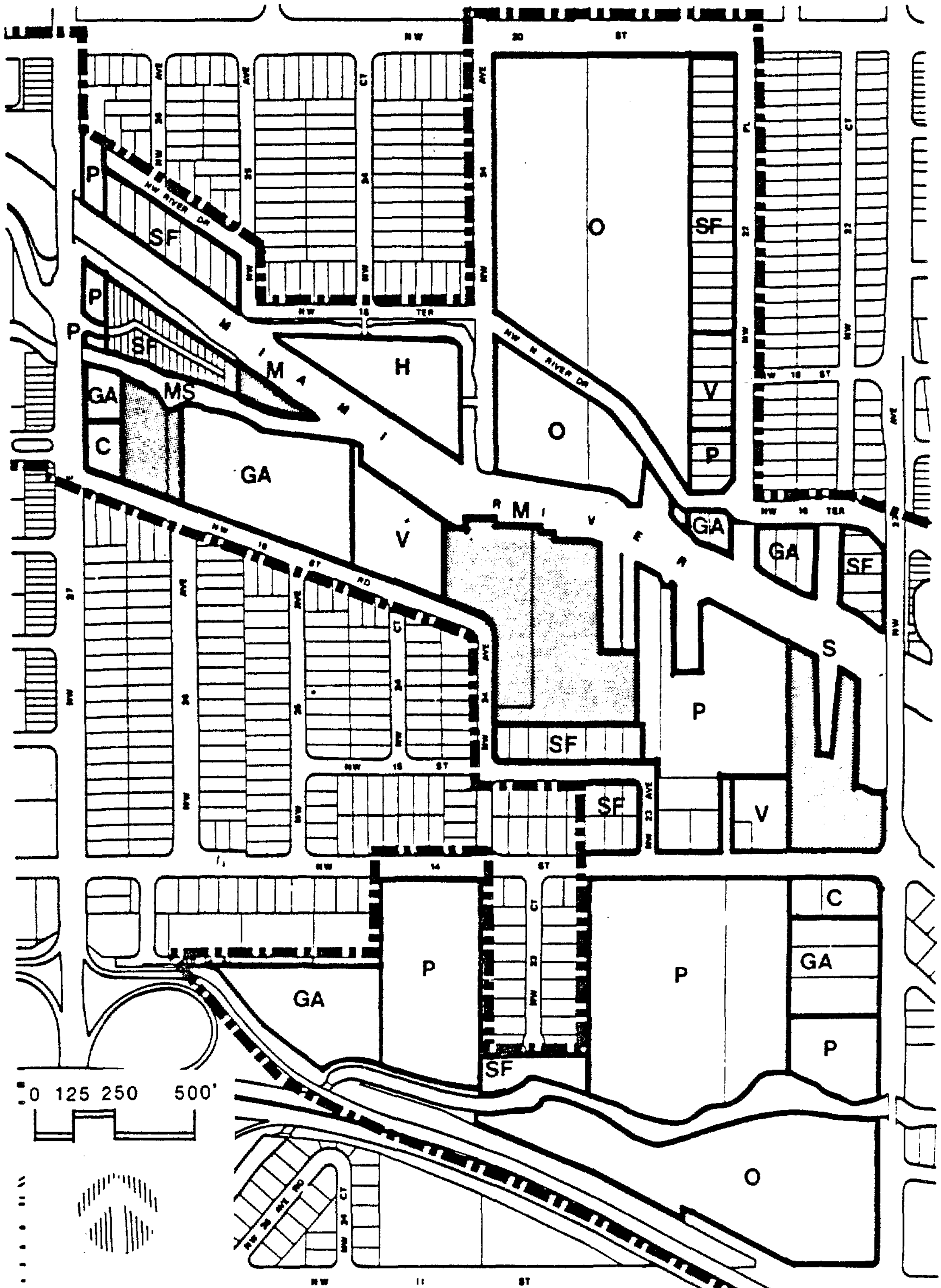
The River channel is 6,110 feet in length from the 17th to 27th Avenue bridges. The widest area of the River in Basin D is just west of 17 Avenue, with a width of 239 feet. The narrowest portion is near 25 Avenue. Water depths range from 14.4' to 15.5' at mean low water (see Figure 114). There are approximately 19 storm water outfalls that discharge into the River, the South Fork and the small canal to the east of Sewell Park in this Basin.

From 17 to 27 avenues, the north bank including embayments and inlets is more than 11,000' long. Over 9,000 of this is vertical bulkhead or cut limerock, with over 2,000 feet unconsolidated and 200 feet in riprap. Of the 10,000+ feet of linear shoreline on the southern bank of Basin D, almost 9,000 feet are vertically bulkheaded, over 1,100 feet are unconsolidated, and 350 feet are riprapped.

East of the 22nd Avenue Bridge, approximately 80 percent of the River's edge is bulkheaded. However, a considerable amount of bulkheading is in need of repair or replacement, particularly along the South Fork River and in Nuta's Boatyard (Figure 123).

West of the 22nd Avenue Bridge, approximately 80 percent of the River's edge is bulkheaded and in generally good condition. However, the bulkheads along the Musa Isle, around Martin's Point (NW 18 Terrace), the end of NW 24 Avenue and at Key Power need repair. The River's edge along Gerry Curtis Park is unconsolidated and seriously eroding. The balance of the River's edge consists of unconsolidated riprap and natural limerock with wood docks of varying quality (Figure 124).

There were a number of changes in both land use and ownerships within Basin D from 1974 to 1984. Construction of River Run at the Merrill Stevens site west of 17 Avenue, townhouse development at the Coppinger site (which was used for boat storage in 1974), and development of the Musa Isle site as a HUD project increased the amount of Riverfront devoted to residential uses by more than 1,000' during the decade (see Figures 111 and 125). The amount of Riverfront used for marine related activities also increased modestly in 1984-85 as formerly vacant lands were used for storage of U.S. Custom's seized vessels at the site southeast of the 22nd Avenue Bridge and for storage of marine and upland construction materials by Florida Marine Construction west of Florida Yacht Basin.



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 122

LAND USE—BASIN D—22nd AVENUE TO 27TH AVENUE BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT
O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

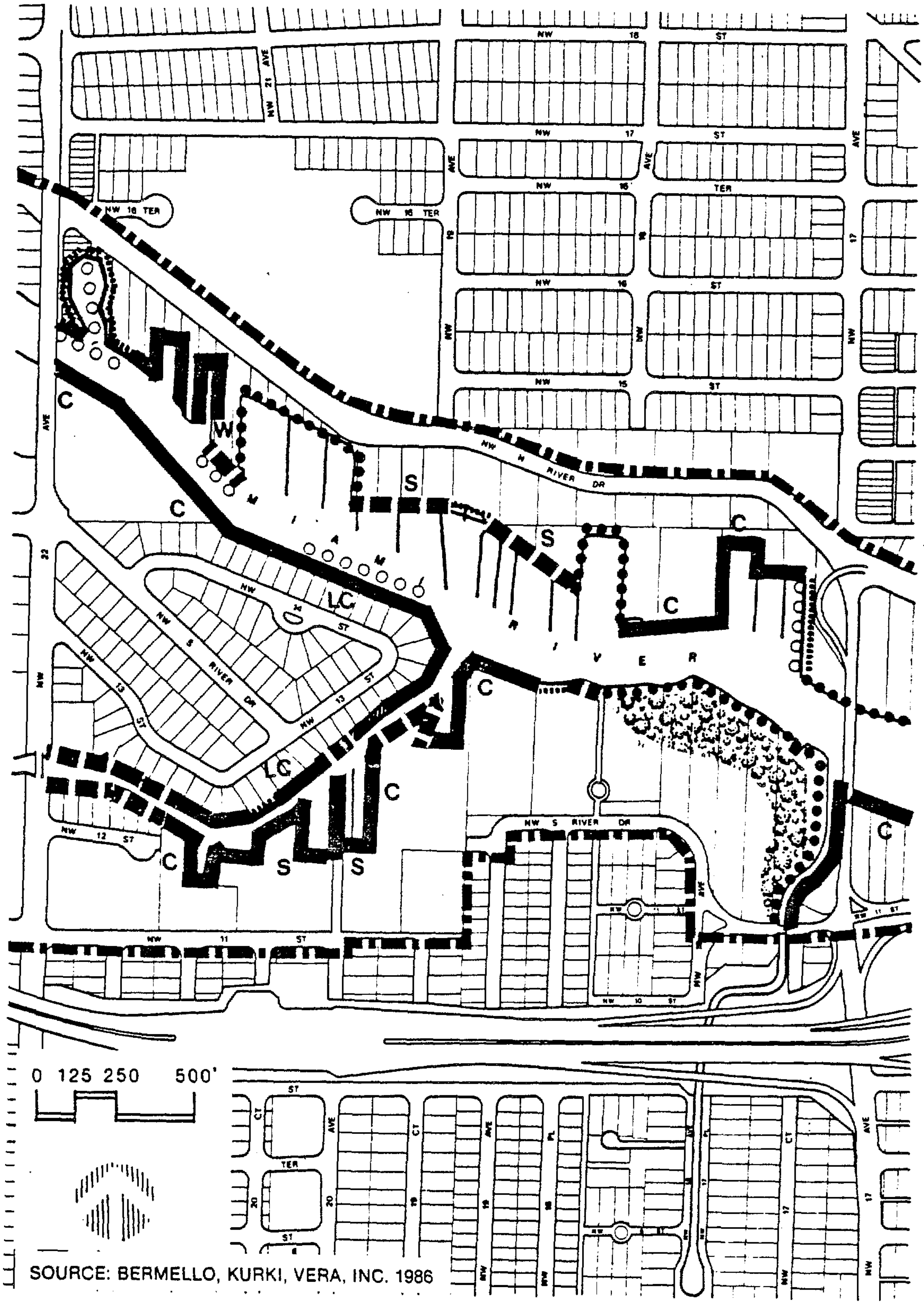


FIGURE 123

RIVER EDGE CONDITIONS—BASIN D—17th AVENUE TO 22nd AVENUE BRIDGE

STABILIZED/GOOD CONDITIONS
STABILIZED/IN NEED OF REPAIR
NATURAL LIMEROCK
RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
C CONCRETE BULKHEAD
S STEEL BULKHEAD
W WOOD BULKHEAD
DOCKS

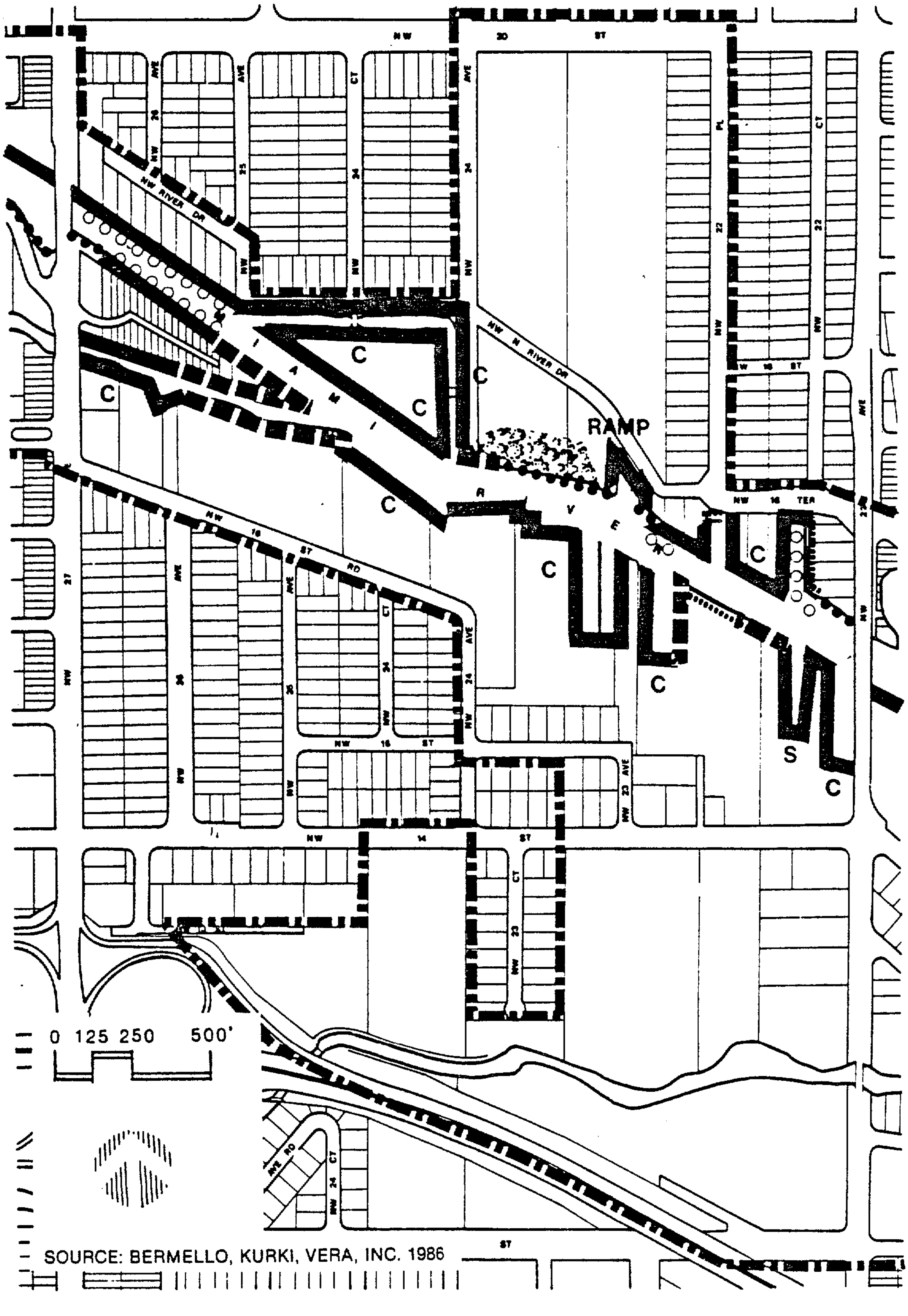


FIGURE 124

RIVER EDGE CONDITIONS—BASIN D—22nd AVENUE TO 27th AVENUE BRIDGE

STABILIZED/GOOD CONDITIONS	UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
STABILIZED/IN NEED OF REPAIR	C CONCRETE BULKHEAD
NATURAL LIMEROCK	S STEEL BULKHEAD
RIPRAP/REVETMENT OR SLOPED CEMENT BAGS	W WOOD BULKHEAD
	DOCKS

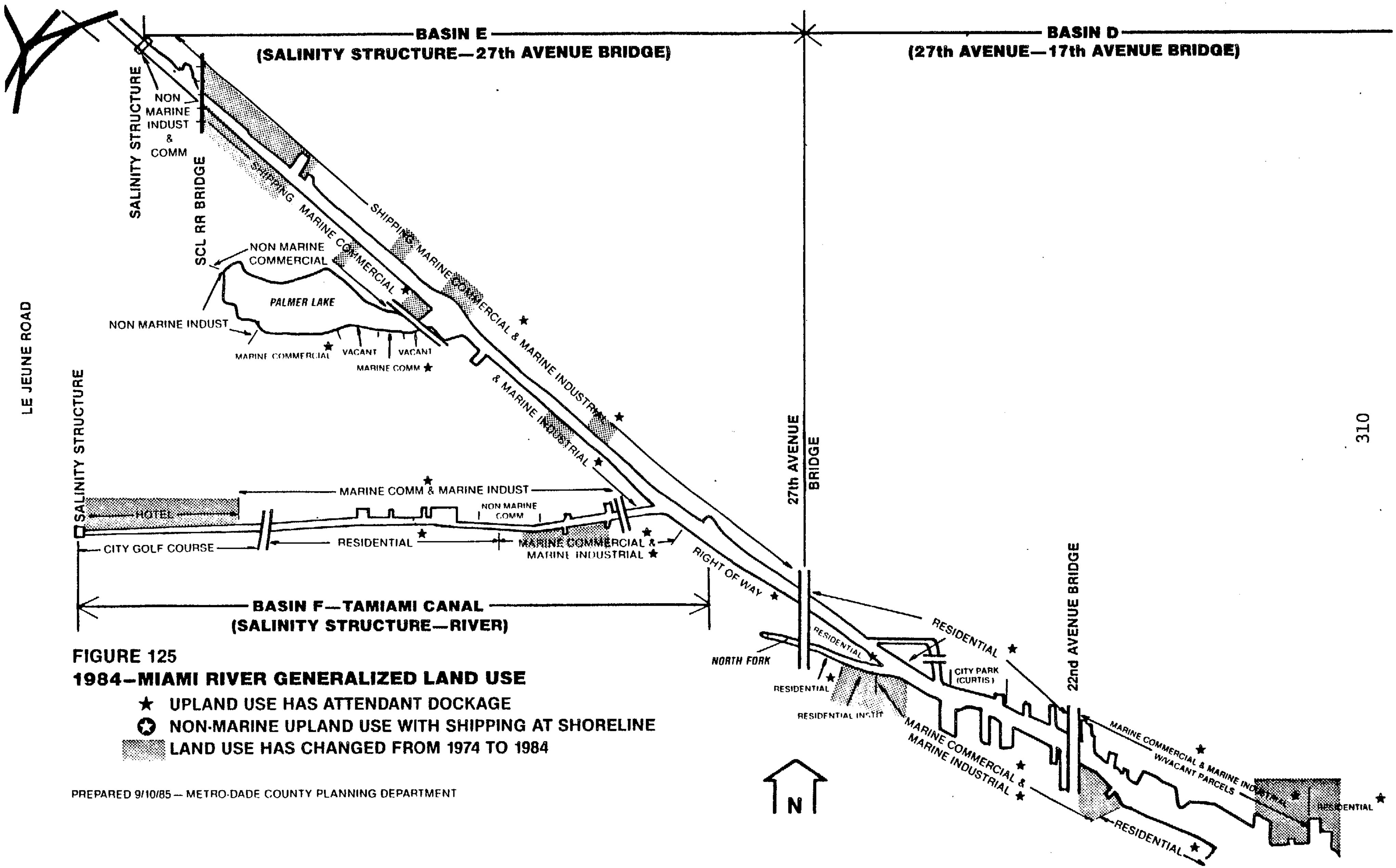


FIGURE 125
1984–MIAMI RIVER GENERALIZED LAND USE

★ UPLAND USE HAS ATTENDANT DOCKAGE
✪ NON-MARINE UPLAND USE WITH SHIPPING AT SHORELINE
▒ LAND USE HAS CHANGED FROM 1974 TO 1984

PREPARED 9/10/85 — METRO-DADE COUNTY PLANNING DEPARTMENT

Total assessed value in 1984 for riverfront property in River Basin D was almost $36 million. Forty-seven percent of this property was tax exempt. Growth in assessments from 1980 to 1984 was almost $13 million.

There was about $100,000 worth of coastal construction activity in Basin D during the period from 1980-85. The River Run Condominium completed work on a seawall and piers for a marina. Allied Marine on the South Fork constructed a seawall with pier and railroad runway (see Figure 113).

TABLE 26

BASIN D - 17th Avenue Bridge to the 27th Avenue Bridge

	1974	1984	Net '74-'84 Change
Vacant/Parking	2,215'	490'	-1725'
Public Park/R-o-W	3,099'	3,099'	no change
Residential	5,685'	6,810'	+1,125' River Run, Coppenger Site Town-houses, Musa Isle HUD
Marine Commercial/Industrial	10,615'	11,215'	+600' U. S. Customs Vessel Storage; Fla. Marine Construction Storage
Non-Marine Commercial/Industrial	0	0	no change
Government/Institutional	150'	150'	no change
Total Linear Frontage, North and South Banks Combined	21,764'	21,764'	

Basin E -- 27th Avenue to Salinity Dam

The one and three quarter mile segment of the River west of 27 Avenue is distinctly different from the preceeding basins. In this heavily industrial area the River becomes narrow and shallow (see Figure 114). Virtually all of the shorelne in Basin E is cut limerock or limerock with bulkhead facing (Figures 126 and 127). Seventeen percent of the bulkheading is in poor condition.

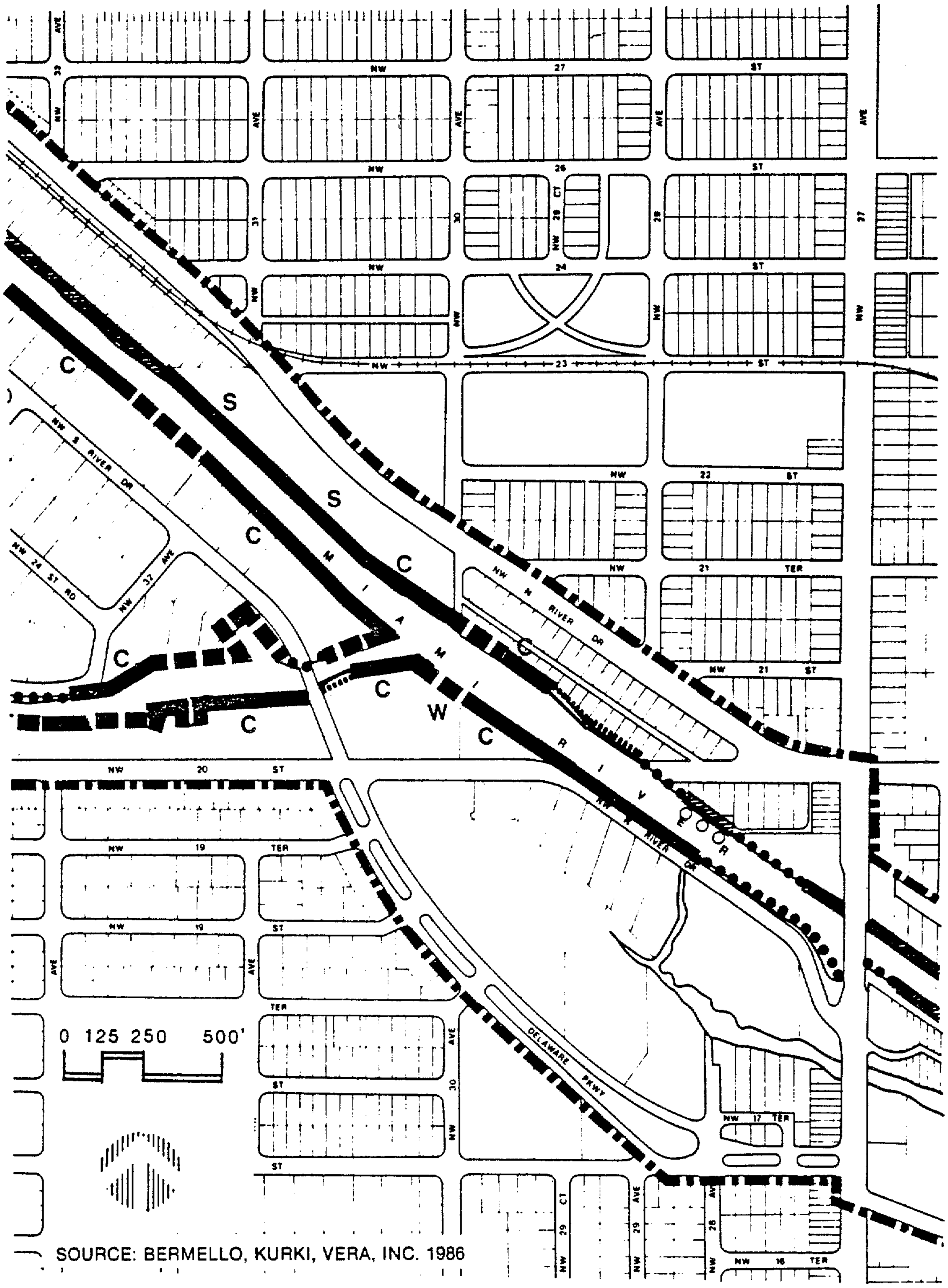
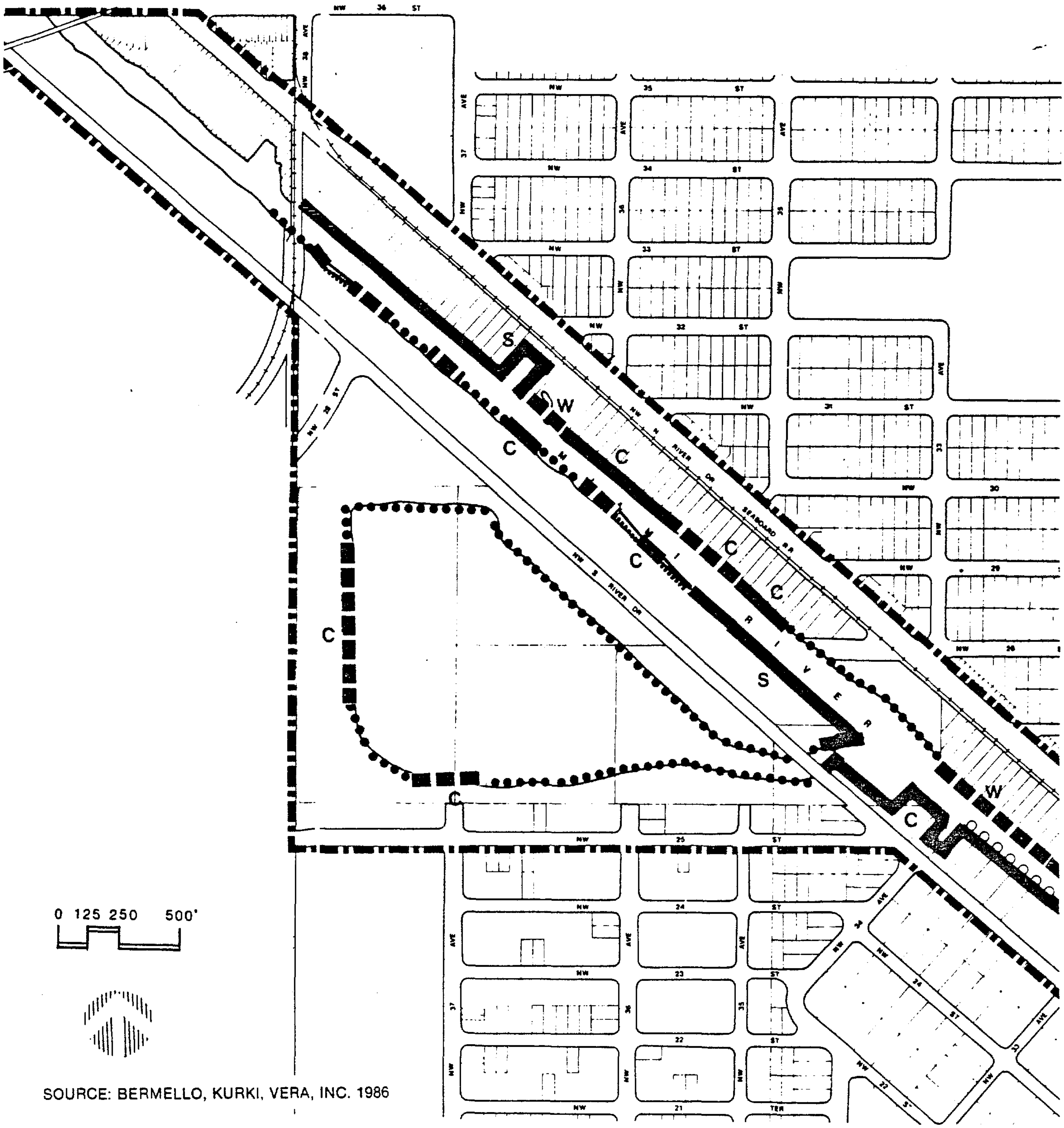


FIGURE 126

RIVER EDGE CONDITIONS—BASIN E—27th AVENUE TO 32nd AVENUE BRIDGE

STABILIZED/GOOD CONDITIONS
STABILIZED/IN NEED OF REPAIR
NATURAL LIMEROCK
RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
C CONCRETE BULKHEAD
S STEEL BULKHEAD
W WOOD BULKHEAD
DOCKS



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 127

RIVER EDGE CONDITIONS—BASIN E—32nd AVENUE TO SALINITY DAM

- STABILIZED/GOOD CONDITIONS
- STABILIZED/IN NEED OF REPAIR
- NATURAL LIMEROCK
- RIPRAP/REVETMENT OR SLOPED CEMENT BAGS
- UNCONSOLIDATED/RUBBLE, SAND OR NATURAL
- C CONCRETE BULKHEAD
- S STEEL BULKHEAD
- W WOOD BULKHEAD
- ooooo DOCKS

This basin underwent significant changes during the 1974-84 decade. The amount of Riverfront in marine commercial and industrial uses increased from 40 to 54 percent, while non-marine commercial/industrial uses declined from 48 to 22 percent. The shift was primarily from scrap yards to shipping terminals (see Figure 125). In 1985 eight of the 13 active shipping terminals on the River were located in this basin (see Table 30), and over half of the shoreline frontage in Basin E was used for shipping terminals (Figures 128 and 129).

During the 1974-84 period the amount of vacant land also increased from four to fifteen percent. While this area bears little resemblance to the downtown urban core Riverfront in Basin A, the two basins share one important feature: both have large vacant parcels of land that are ripe for development. The changes in Riverside usage are tabulated below.

TABLE 27

1974-1984 Land Use Changes
Basin E - 27th Avenue Bridge to Salinity Dam

	1974	1984	Net '74-'84 Change
Vacant/Parking	560'	2,485'	1925 (450' under construction, 1985; 1,850' used for ship moorage)
Public Park/R-o-W	1,795'	1,795'	no change
Residential	0	0	no change
Marine Commercial/Industrial	6,925'	9,390'	+2,465'
Non-Marine Commercial/Industrial	8,375'	3,760'	-4,615'
Government/Institutional	0	225'	+225'
Total Linear Footage - North and South Bank	17,655'	17,655'	

The total assessed value of land in this area increased 105 percent during the 1980-84 period. In 1984 the total assessed value was just over $28 million. Between June 1980 and October 1985 there were 21 applications for coastal construction in this Basin. Permitted activities included seawall repairs, bulkheading and construction of piers and pilings, and maintenance dredging. These improvements cost in excess of $328,800.

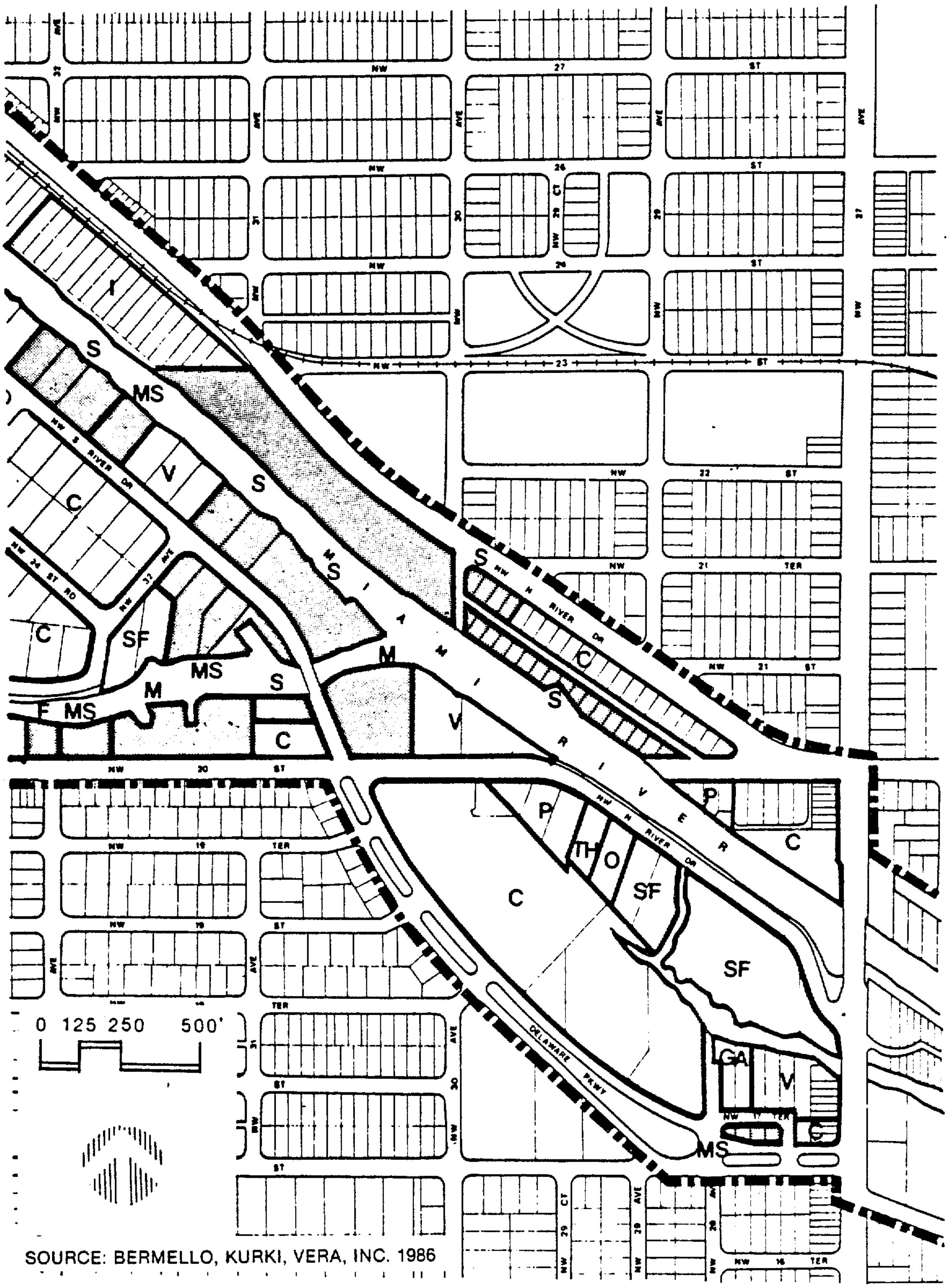
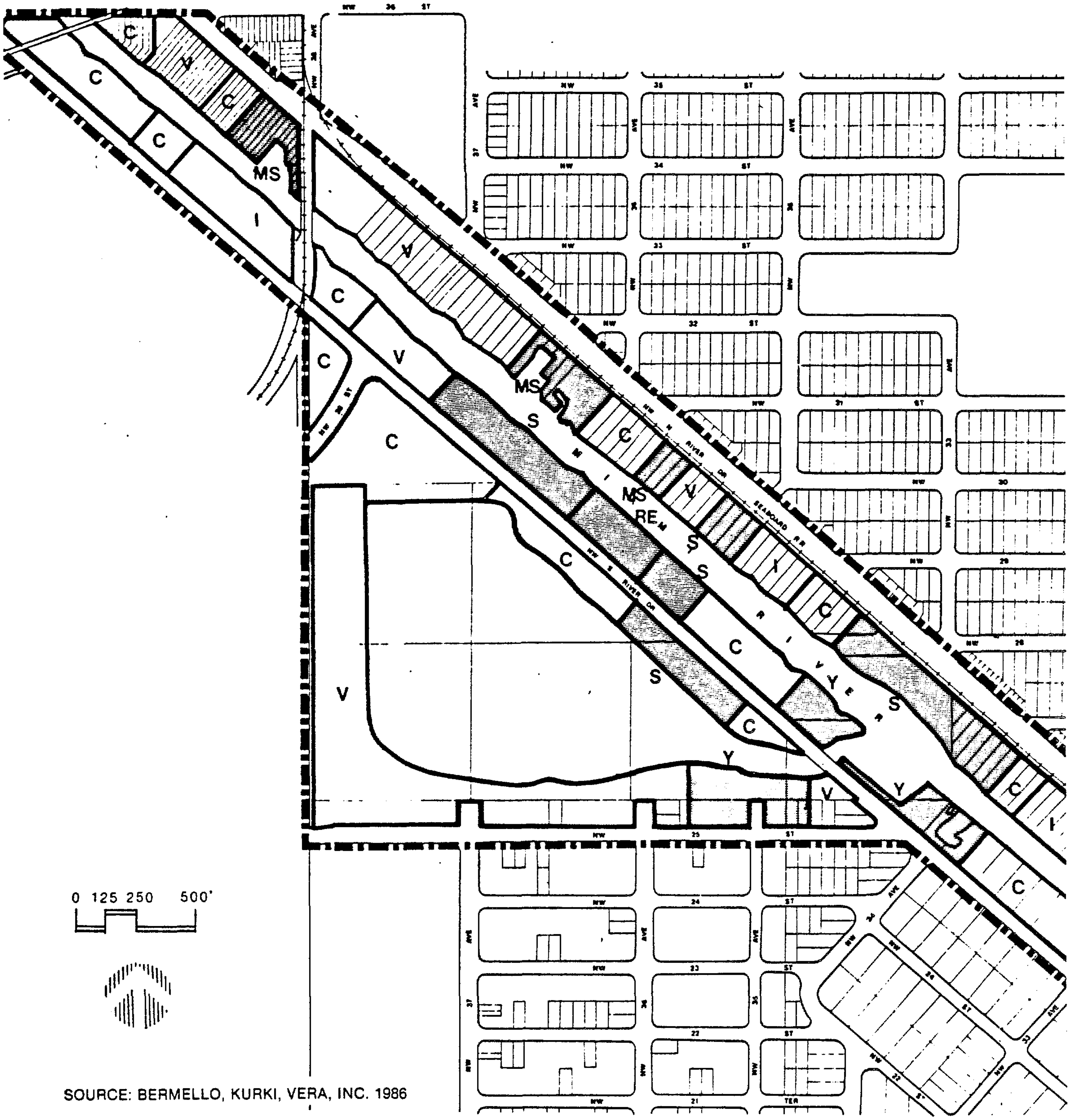


FIGURE 128

LAND USE—BASIN E—27th AVENUE TO 32nd AVENUE BRIDGE

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/PARKING
V—VACANT
O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED



SOURCE: BERMELLO, KURKI, VERA, INC. 1986

FIGURE 129

LAND USE—BASIN E—32nd AVENUE TO SALINITY DAM

SF—SINGLE FAMILY
TH—TOWNHOUSE
GA—GARDEN APARTMENT
H—HIGH-RISE APARTMENT
C—NON-MARINE COMMERCIAL
I—NON-MARINE INDUSTRIAL
P—PUBLIC/INSTITUTIONAL
T—TRANSPORTATION/UTILITIES/ PARKING
V—VACANT

O—OPEN SPACE & RECREATION
M—MARINAS & MINOR REPAIRS
MS—MARINE SALES, ACCESSORIES/ SERVICE
F—FISHERIES
RE—RESTAURANTS
Y—BOAT YARD/MAJOR REPAIR
S—SHIPPING & CARGO
—MARINE RELATED

WATER AND SEDIMENT QUALITY

Water quality within the Miami River has changed dramatically, from clear, drinkable waters, as late as 1909, to the murky waters of the River today. Unlike the generally unstratified saline waters of Biscayne Bay, the Miami River water column is highly stratified with differences in bottom and surface water salinities measuring as much as 20 parts per thousand (DERM, 1985). The River water also varies from slightly brackish at the upper reaches to saline at the mouth.

Water Quality

As discussed in Chapter I, the poorest water quality in the entire APMA is found at the mouth of the Miami River. Monthly sampling at seven stations within the River since 1984 has provided additional information on the extent of the River's pollution. Along the entire length of the River below the salinity dam, total and fecal coliform counts exceeded State and local Water Quality Standards throughout 1984.

Dissolved Oxygen (D.O.) at the bottom of the River was below acceptable levels at all stations except the one at the mouth of the River throughout 1984 (Figure 130). Anoxic conditions (totally lacking oxygen) were recorded during water quality sampling in May and October of 1983 in the bottom waters at the uppermost reaches of both the Miami River and the Tamiami Canal (Ryan, et al, 1985).

At the mouth of the River average turbidity values were almost twice the concentrations measured up River, but the highly turbid waters were generally confined to the area just Bayward of the River's mouth. Ryan, et al (1985) found turbidity levels at the mouth of the River to be extremely high and in violation of State Water Quality Standards. Ryan (personal communication) hypothesized that this may have been due to an unusual weather event or tidal cycle. DERM has observed elevated levels of turbidity, Total Non-filterable Residue and lead in the water column over two hours after the passage of a freighter and tugs.

Color and nutrients, including organic nitrogen, ammonia, and phosphate enter the River from the Miami Canal above the salinity structure, however, nitrate is low at the salinity control structure. The level of nitrate is highest at the junction with the South Fork of the River and then gradually declines down River (DERM, 1985).

Ryan, et al (1985) found that metals concentrations in the water column met State Water Quality Standards. Also, synthetic organics such as PCB's, which only remain in the water column for short periods of time, were not present in detectable levels in Miami River waters during 1983 sampling (Ryan, et al, 1985).

Sediment Quality

As discussed in Chapter 1, most pollutants introduced into estuarine waters become bound to particles in the water column and quickly settle out to the bottom. Because of this, water quality criteria provide only a partial accounting of pollutants within estuarine water bodies, and bottom sediments have come under scrutiny as the long term indicators of pollution within these systems. Ryan, et al, (1985) and Corcoran, et al (1984), analyzed sediments from the Miami River and came up with a much bleaker assessment of pollution than water quality monitoring had indicated.

Concentrations of pollutants in Miami River sediments were generally higher downriver and lower upriver (Ryan, et al, 1985). Chromium, cadmium, mercury, lead, copper and silver levels in the sediments were considerably higher than at any of the other Florida ports (see Table 8). Synthetic organic compounds (i.e. pesticides, PCB's and hydrocarbons), were found in the sediments at only four ports in the State. Alarmingly, the Miami River sediments contained the most diverse group of these compounds.

Corcoran et al (1983) described the spatial distribution of hydrocarbons in Biscayne Bay and its tributaries. The authors found that the concentrations of hydrocarbons in the River were ten times higher than at any other location in the state of Florida and that the hydrocarbons within the Miami River were completely mixed in the sediments. The authors attributed this to the heavy ship traffic which resuspends and redistributes the sediments daily.

IMPACTS ON RIVER QUALITY

Water and sediment quality within the Miami River are not only affected by in-water activities such as the discharge of bilge and wastewater from vessels, but also by upland and shoreline activities and conditions, including, storm water and overland runoff, combined stormwater/sewage overflows, eroding shorelines and deteriorating upland structures. Each of these will be discussed in terms of the problems they cause, current solutions and further recommended corrective measures.

Storm Water and Overland Runoff

It is the professional opinion of scientists and agency personnel who have studied the River that storm water outfalls are the major source of pollutants entering the River. Along the River and its tributaries, there are 55 storm water outfalls measuring more than one foot in diameter (DERM, 1981). These outfalls drain roadways, as well as heavily urbanized areas. About four square miles of multi- and single family residential, industrial, commercial and institutional areas drain into the River (Figure 130). Table 28 gives a breakdown of land uses within the River drainage basins.

Storm Drainage Basin Ranking. Swakon (1984) used the drainage basin acreage and land use information together with data from the U.S. Geological Survey (1979) on nutrients in stormwater from various land uses, to calculate hypothetical River pollutant loadings, and to rank the drainage basins from "worst" to "best." Since the U.S.G.S. pollutant loading

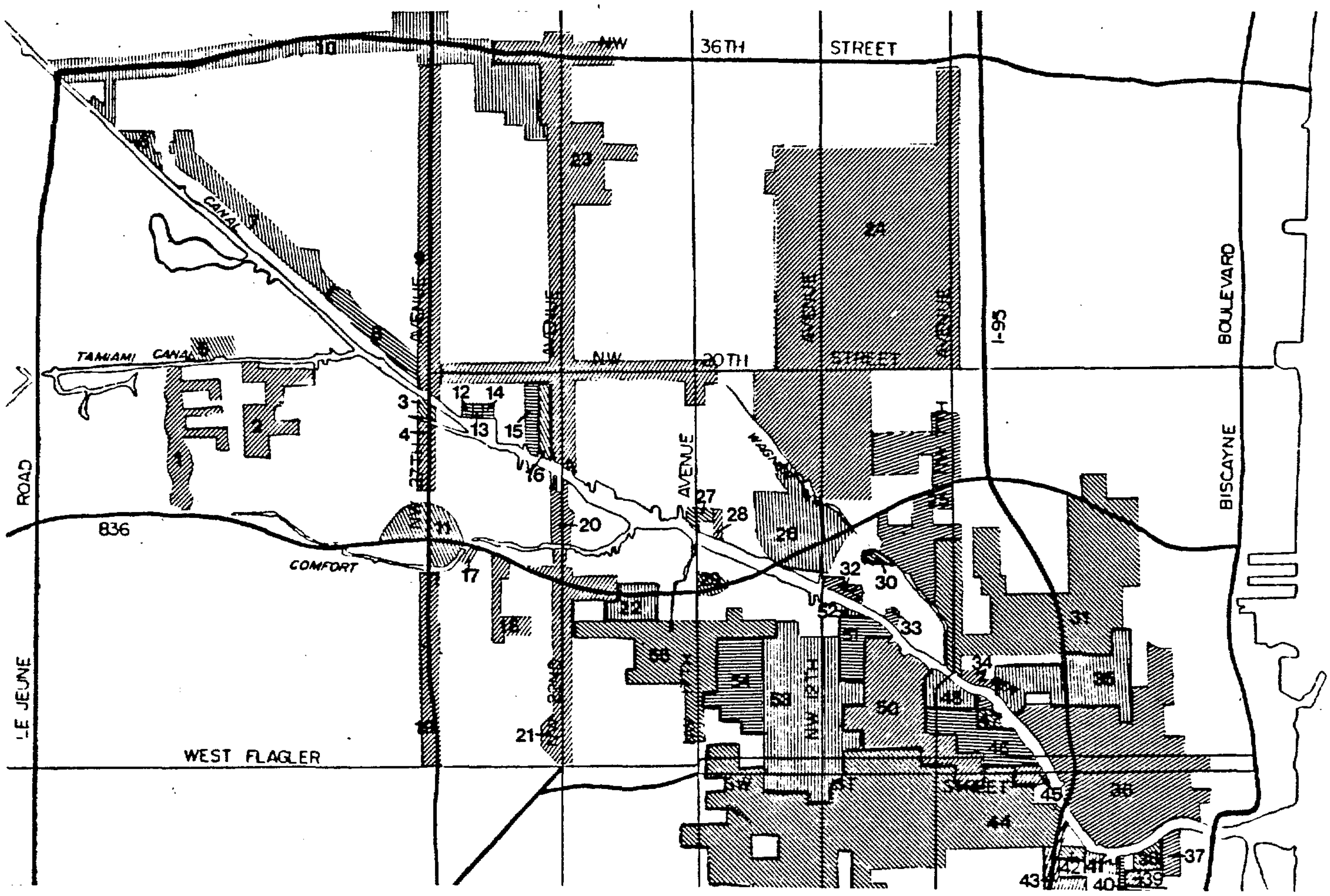


FIGURE 130

STORM WATER BASINS THAT DRAIN INTO THE MIAMI RIVER

STORM WATER DRAINAGE BASINS

SOURCES: METRO-DADE DERM FILES &
METRO-DADE PLANNING DEPT., 1985

TABLE 28

Land Uses Within Miami River Drainage Basins

Use	% of Total
low density residential	15.7%
high density residential	25.0
major roadways	7.5
commercial (i.e. stores)	19.9
commercial (potential waste generating, i.e. dry cleaners)	3.9
industrial	
light	5.3
marine	2.0
heavy	2.4
potential waste generating	5.7
institutional (i.e. hospitals)	8.7
open space	3.8
	100.0

figures did not include heavy metals or hydrocarbons, these rankings are indicative of nutrients, but not total pollutants in storm water runoff. The worst drainage basin (#44 on Figure 138) includes 336 acres of high density residential and commercial land uses from Flagler to SW 8 Streets and east to the River from 17 Avenue. The three next "worst" basins (#s 31, 53, and 50) are also predominantly high density residential with commercial land uses. The fifth ranked basin (#54) is predominantly institutional with some high density residential. The sixth and largest basin (#24), includes the hospitals, clinics and medical labs in the Civic Center area.

Hazardous Waste Generators. Three of the designated Superfund sites in Dade County are located along the Miami River or canals that are connected to the River. The first site was Miami Drum at 7049 NW 70 Street, where large scale excavation and removal of contaminated soils and treatment of polluted groundwater took place. At the Pepper Steel Plant at 11100 NW South River Drive, wastes from metal reclamation and battery manufacturing activities contaminated thirty acres of soils and groundwater with lead and PCB's. The third Superfund site was located in the Eastern Airlines complex at Miami International Airport where varsol fluid leaked from underground lines for an unknown period of time. This was closed as a Superfund site following replacement of the leaking pipe lines.

In the period from 1983-1985, fifteen other soil/water contamination sites and twenty-six fuel spill sites (including nine at Miami Internationa Airport) were investigated by DERM within a few blocks of the Miami River or its tributaries. Twenty-five percent of all soil/water contamination or fuel spill sites in Dade County were located in close proximity to the River or its tributaries.

TABLE 29

Soil/Water Contamination and Fuel Spill Sites
1983-1985

	Countywide	Near River and Tributaries
Superfund Sites:	7	3
Other Soil/Water Contamination Sites	88	15
Fuel Spills in excess of 500 gallons	51	21 (9 MIA)
Fuel Spills less than 500 gallons	32	5
Other Chemical Spills	3	1
Total	181	45

In addition to these documented problem areas, there are hundreds of potentially contaminating commercial and industrial uses that occur along the River, its tributaries and the storm water basins that drain into these water bodies.

What is Being Done. The County has initiated programs that address the problems of industrial waste generation, fuel spills and underground leaks. These programs are Countywide in scope, but they will help to alleviate some of the more significant water pollution problems in the River area. The underground tank and small waste generators programs were established to identify problem sites and to educate the owners of potentially polluting businesses about good management and disposal practices. However, if an owner or operator persists in violating County codes, then the regulatory arm of DERM steps in to carry out enforcement actions, which may include court action, if warranted.

The County has established a series of recovery wells in Miami International Airport and monitoring wells and surface water monitoring stations in and around the perimeter of the airport. By the end of 1985, in excess of 262,000 gallons of fuel had been recovered on site. Similar recovery operations were carried out at other soil and water contamination sites and a major recovery operation was planned for the Metro-Dade Bus Yard at 3300 NW 32 Avenue in 1986.

The County also has permitting and regulatory programs that govern discharges of storm water and "dewatering" or settling out of water from construction sites before it is released into a storm water system. The storm water permitting program requires all new development to retain the first inch of rainfall on site, if possible. This program is carried out under an agreement with the South Florida Water Management District which has delegated authority to DERM for most of the storm water permitting in Dade County. In addition to the programs that are targeted at certain businesses or activities, the County Code provides that anyone violating existing State or County surface or groundwater water quality standards can be cited and ticketed by DERM pollution control inspectors at the time of the violation.

In recent years several major roadway projects were undertaken along the River or its tributaries. These projects incorporated the use of underground detention systems, thereby improving the quality of water entering the River from these roadways. In 1985 Florida DOT made road improvements along Okeechobee Road, SW 7 Street, 27 Avenue and Brickell Avenue and initiated improvements along I-95. In addition, Community Development grant funds were used in the Melrose area (west of 27 Avenue) to provide better flood protection and take some of the pressure off storm water drainage systems along 27 Avenue and 36 Street.

In 1978 and 1984 the City of Miami passed bond issues to provide drainage improvements and upgrade flood protection in downtown Miami and several neighborhoods which drain into the Tamiami, Comfort and Seybold Canals, the Miami River, Little River and Biscayne Bay. The City has made improvements to the existing drainage system by constructing detention facilities within the area bounded by SW 1 Street, SW 17 Avenue, SW 8 Street, and SW 12 Avenue. This represents about one-third of the area described as the "worst drainage basin" on page 214. Additionally, storm drainage systems on SW 2 Street, SW 3 Street and SW 4 Street were upgraded between SW 6 Avenue and the Miami River as part of the East Little Havana Highway improvement. The City enclosed approximately 1,750 lineal feet of Wagner Creek (Seybold Canal) with a box culvert north of NW 20 Street at a cost of $1,100. This will eliminate the illegal dumping which has occurred in this area in the past. The 1986-87 City public works schedule will include similar construction and cleanup of Seybold Canal from NW 14 Avenue to NW 20 Street, at a cost of $1,800,000 and improvements to North River Drive between SW 2 Avenue and NW 5th Street Bridge and NW 8 Street road, adjacent to the Seybold Canal from NW 7 Avenue to the 836 Expressway.

As part of its 1984-89 capital improvement program, the City has developed a comprehensive drainage master plan. This plan includes an evaluation of the effectiveness of structural and nonstructural drainage control measures and devices for reducing pollutant concentrations in receiving waters.

During the 1986 Florida Legislative session, $535,000 was appropriated for improvements in Biscayne Bay and the Miami River. About half of that amount will be used to upgrade storm water outfall systems in that drain into the Miami River.

In addition the County and City of Miami have worked with the Miami River Coordinating Committee to obtain U.S. Congressional authorization for dredging the polluted sediments from the Miami River. The U.S. Army Corps of Engineers has done a feasibility study and determined that there are in excess of 520,000 cubic yards of sediments in the Miami River. The Corps has estimated that about $8 million will be required for dredging and disposal of these sediments. During the 99th session of the U.S. Congress, a bill passed authorizing funds for dredging the River.

Combined Sewage/Storm Water Overflows

During extreme rainstorms, the combined storm water/sewage flows are so voluminous at the pump station at NW 4 Street that they cause the system to back up and overflow into the River. The pumps at this station are old and subject to breakdowns. In addition, several of the older sanitary and storm water lines in the City of Miami are interconnected (Austin, personal communication). Even where they are not directly interconnected, the older systems are subject to infiltration when the water table is high. In times of heavy rain, this can substantially increase the amount of water in the sewer system and cause combined stormwater/sewage overflows for days after the rain has ceased.

What is being done. The Metro-Dade Water and Sewer Authority Department has included more than $300,000 for replacing the old pumps at the 4th Street Pump Station in its FY '87 budget. The new pumps will greatly increase both the capacity and reliability of the station. Additional funds are also being sought for the Fiscal Year 1988 budget to make further improvements at this booster station.

During the past few years the City of Miami has placed high priority on road improvements in areas where there are known combined sewer/storm water systems. Whenever such systems are located, they are upgraded and the interconnections are capped (Kay, personal communication, 1986).

Discharge of Waste Water, Sewage and Oily Bilge Water From Vessels

Observation of 1985-86 aerial photographs revealed that there were about 430 vessels docked along the banks of the Miami River and its tributaries. According to Holeman (1986) any of these vessels that are greater than 35 feet in length can be considered to be liveaboard vessels. The number of these boats that comply with U.S. Coast Guard marine sanitation laws is unknown, and the U.S. Coast Guard has indicated that it will not inspect for compliance with marine sanitation laws unless it is boarding a vessel for some other reason.

What is Being Done. Since the establishment of the Federal marine sanitation requirements in 1970s, it was understood that there could be no delegation of authority to enforce marine sanitation device laws from the Coast Guard to State or local pollution control agencies. However, in 1985 the State of Florida ascertained that the Coast Guard could delegate this authority to a qualified and willing state agency. The Florida Department of Environmental Regulation has notified the Coast Guard that it would welcome delegation of this authority.

In March 1986 the Coast Guard started to enforce laws which prohibit the discharge of bilge water at sea. These laws require all terminals which serve vessels larger than 400 tons to provide bilge pump out facilities. Twelve shipping terminals on the Miami River have joined together and contracted with a firm to provide a mobile pumpout facility to serve this need.

The Coast Guard has primary responsibility for regulating and overseeing the clean up of oil spills. They are assisted in this function by several agencies including: FDNR, Metro-Dade and Miami marine patrols and DERM. DERM has also established a voluntary oil disposal program which provides information about proper oil disposal methods and locations.

Deteriorating, Derelict and Seized Vessels

There are no local facilities where unwanted boats can be taken for disposal. Many vessels are stripped of their identification and then abandoned. There are also a number of docked or moored vessels along the River that are in deteriorating condition, some which are partially or fully submerged. During a survey of the River in July 1985, the City of Miami Marine Patrol identified thirty deteriorating and/or submerged vessels along the River and its tributaries. By early 1986 several of those vessels had been removed but almost as many "new" deteriorating vessels were identified. FDNR conducted an independent survey of deteriorating vessels in the River in 1985. The FDNR survey identified twenty-four vessels that were potentially suitable for placement on the County's artificial reefs. Some of those were U.S. Custom's seized vessels that are being stored until forfeiture procedures can be completed and the vessels can be sold.

What Is Being Done. Several Federal, State and local agencies are involved in ridding the area of abandoned and deteriorating vessels. However in the past their efforts were not coordinated. The DNR Marine Patrol designated numerous vessels in the River as "derelict" and removed a number of those over the years. For several years the State Legislature did not fund derelict vessel removal programs, but they reestablished funding for these programs during the 1985 session.

The County's derelict vessel code was written to address the problem of abandoned and valueless vessels in Dade County's waterways. There is a misconception that the County can order a vessel to be removed if the vessel is improperly moored or unsightly. The County can remedy the problem of illegal moorage, but cannot dispose of a vessel simply because it is improperly moored or unsightly. The County's code is a cumbersome tool to use for the disposal of large vessels due to the requirement that the vessel must be proven both valueless and abandoned. However, it has been used to remove several small boats from the River.

In spite of legal and administrative obstacles, Dade DERM oversaw removal of eighteen ships from the River during the period from 1981 through 1985. These vessels were placed on the sixteen permitted artificial reef sites that are located in the Ocean from the Broward County line to the Monroe County line, two and one half to four miles offshore.

By the end of 1985, the problems of derelict and abandoned vessels had begun to be resolved. The State of Florida initiated a derelict vessel grant program. Inflexibility in the administration of these contracts, however, slowed the progress of expending the $61,000 allocated to Dade County.

The City of Miami enacted a vessel mooring code in 1985 to alleviate the problem of abandoned and derelict vessels within City limits, particularly at Dinner Key and along the Miami River. One year after the inception of the City of Miami Mooring Code, 12 violations on the Miami River had been acted upon. Seven vessels were removed or corrected. The remaining five vessels were sitting on the bottom, the owners had been legally notified, and citiations were being processed.

In 1984 the U.S. Congress enacted a law which permits the U.S. Customs to expeditiously dispose of a vessel that is valued at less than $100,000 or that has been used to transport contraband. In mid-1985 Senator Lawton Chiles held a hearing to determine why the 1984 law had not been used and why several seized vessels had been stored along the River for years at costs that far exceeded their value. As a result of the Senator's initiative, ten vessels were placed on inshore and offshore reefs by DERM and no additional seized vessels were placed on the River for storage during 1985. Six months after the Senator's first hearing, over one hundred seized vessels had been removed from the River.

In 1985 the U.S. Customs Service also selected a private firm to oversee the storage and maintenance of seized vessles. As a result, much stricter administrative standards have been established and this process is being much more closely monitored than it was previously.

Shoreline Conditions

In May 1984 County staff surveyed the conditions along the River shoreline and identified more than fifty sites where bulkhead, shoreline and upland problems existed. The problems observed included health hazards, dilapidated buildings, trash, litter, and deteriorating and unsafe structures. The list of problems was forwarded to the appropriate City and County officials. The River was resurveyed by County staff in the summer of 1985. In some instances improvements were noted, however, in most cases, the problems noted in 1984 still existed and several additional problem areas were observed.

Some of the vertical shorelines of the River consist of the natural limestone which was cut when the River was channelized. In many cases the limerock surface was capped with concrete, and sometimes with wood. Many of the concrete and/or wood caps are dilapidated. West of 27th Avenue, where erosion behind dilapidated bulkheading is severe, people have resorted to using creosote pilings, lumber, tires and assorted debris to fill and protect their shoreline from further erosion.

Throughout the River, the configuration of the shoreline is irregular, and consists of numerous bays and inlets, which trap trash and debris. The trapped material decomposes and creates health hazards as well as aesthetic problems.

The wave energy and tidal flow have caused erosion and exacerbated turbidity levels within this narrow water body. Some shoreline areas, including Sewell and Curtis Parks, have eroded to a point where trees and other landscaping are falling into the River.

What is Being Done. Within the City of Miami unmaintained upland areas, and deteriorating shoreline structures at or below mean high water (including bulkheads, seawalls and docks) are regulated by the City of Miami Public Works Department. Upland building and zoning violations fall under the jurisdiction of the Code Enforcement Section of the City's Building and Zoning Department. Violations of City Code are referred to the City's Code Enforcement Board. Building code violations are referred to the County's Unsafe Structures Board.

In unincorporated Dade County, the Metro-Dade Public Works responds to environmental nuisance problems such as overgrown Riverbank areas. Metro-Dade's trash removal vessel (Ms. Cleanup) removes trash and debris from the River and its shoreline four days a week. Deteriorating structures below mean high water are tenuously regulated by Chapter 33 (Zoning) of the Dade County Code and Chapter 24 of the Dade County Code if the structure was permitted by DERM after June of 1980. Building code violations and unsafe structures in the unincorporated area are under the jurisdiction of the Metro-Dade Building and Zoning Department.

The Board of County Commissioners changed the County's code enforcement procedures in May 1985 to shorten the period of time between reporting and adjudication of alleged violations, to give greater priority to nonemergency code violations and to encourage compliance prior to hearing. The adopted changes allow code enforcement cases to be heard by a special master during an administrative hearing rather than being adjudicated in court. This should shorten the amount of time that is required to process such cases. In addition, County code enforcement inspectors were granted the authority to issue tickets in the field to alleged violators. This should encourage compliance prior to hearing.

The preceding discussion focused on how the River affects water quality in the Biscayne Bay Aquatic Preserve, and measures that taken to minimize negative impacts. However, in order to appreciate the River's role as part of the Biscayne Bay Aquatic Preserve one must also consider how the uses of the Riverfront individually and collectively, enhance or diminish the utility of the Preserve.

UTILITY OF THE RIVER

The Miami River shoreline provides space for water dependent and water related uses which enhance the overall utility of the Preserve. These include shipping terminals; boat storage, building and repair facilities; fish houses and terminals; and marine towing, salvage and construction operations. Some of these facilities provide goods and services not found elsewhere within Dade County.

In addition, there are marine related uses and facilities that enhance public access to the Preserve. Most notable are shoreline restaurants that provide transient dockage, and other shoreline businesses or parks which include boat ramps or shoreline walways. The following section discusses the amount of shoreline devoted to each of the water dependent and water related uses mentioned above, the relative "share" of each use provided along the Riverfront, and problems or opportunities associated with the provision or expansion of particular shoreline uses. This section concludes with a discussion of factors that may affect the utility of the River area and recommendations for minimizing negative impacts.

Shipping Terminals

In 1985-86, thirteen shipping terminals (Table 30) served about 30 shipping agents and lines engaged in commercial trade with more than 50 ports of call throughout the Caribbean and in northern South America (Figure 131). There are about forty ships plus an unknown number of Haitian vessels, that regularly call in the Miami River. More than one and one-quarter mile or about one tenth of the River frontage is devoted to this use.

Many of the ports of call visited by these ships can only be served by the shallow draft smaller ships that use the River terminals. The River, in effect, serves as a lifeline for many small ports and out island areas. This contrasts sharply with the Port of Miami which engages in worldwide trade and receives more gross value in imports that it exports.

Ships entering the River are limited by the width the 5th Street Bridge which is effectively 55' wide, as well as by depth. The smallest vessels range from 100'-135' and come into the River under their own power. These ships dock primarily at Denizana Shipping in Basin B. The largest ships coming into the River in 1986 were about 45½' wide, 273' long, with a draft of 14 to 14.5 feet. These larger freighters carry 1,500 foot tons (3 million pounds). On the average, eight ships longer than 90' enter or depart from the River daily, including four or five ships which must be towed.

FIGURE 131

LEGEND

1. Anguilla, Leeward Islands
2. Antigua, BWI (British Windward Islands)
3. Aruba, Netherland Antilles
4. Barbados
5. Barranquilla, Colombia
6. Belize
7. Bimini
8. Bonaire
9. Caicos
10. Cartagena, Colombia
11. Isla De Cozumel
12. Curaçao
13. Dominica, Leeward Islands
14. Eleuthera, Bahamas
15. Georgetown, Bahamas
16. Georgetown, Guyana
17. Grand Cayman
18. Grand Turk
19. Grenada, Windward Islands
20. Guadeloupe, French Leeward Islands
21. Isla De Margarita
22. La Guaira, Venezuela
23. Guanta, Venezuela
24. Isla Mujeres, Mexico
25. Kingston, Jamaica
26. La Romana, Dominican Republic
27. Long Island, Bahamas
28. Montego Bay, Jamaica
29. Monserrat, British Leeward Islands
30. Nassau
31. Panama
32. Paramaribo, Surinam
33. Port au Prince, Haiti
34. Progresso, Mexico
35. Providenciales, Caiços
36. Puerto Castilla, Honduras
37. Puerto Cabello, Venezuela
38. Puerto Cortes, Honduras
39. Puerto Limon, Costa Rica
40. Puerto Plata, Dominican Republic
41. Puerto Ordaz, Venezuela
42. Isla De San Andres
43. Puntarenas, Costa Rica
44. Santo Domingo, Dominican Republic
45. Santo Thomas, Guatemala
46. St. Barthelemy, French Leeward Islands
47. St. Kitts, Leeward Islands
48. St. Lucia, Windward Islands
49. St. Martin, Netherlands Antilles
50. St. Vincent, British Windward Islands
51. Tortola, British Virgin Islands
52. Trinidad

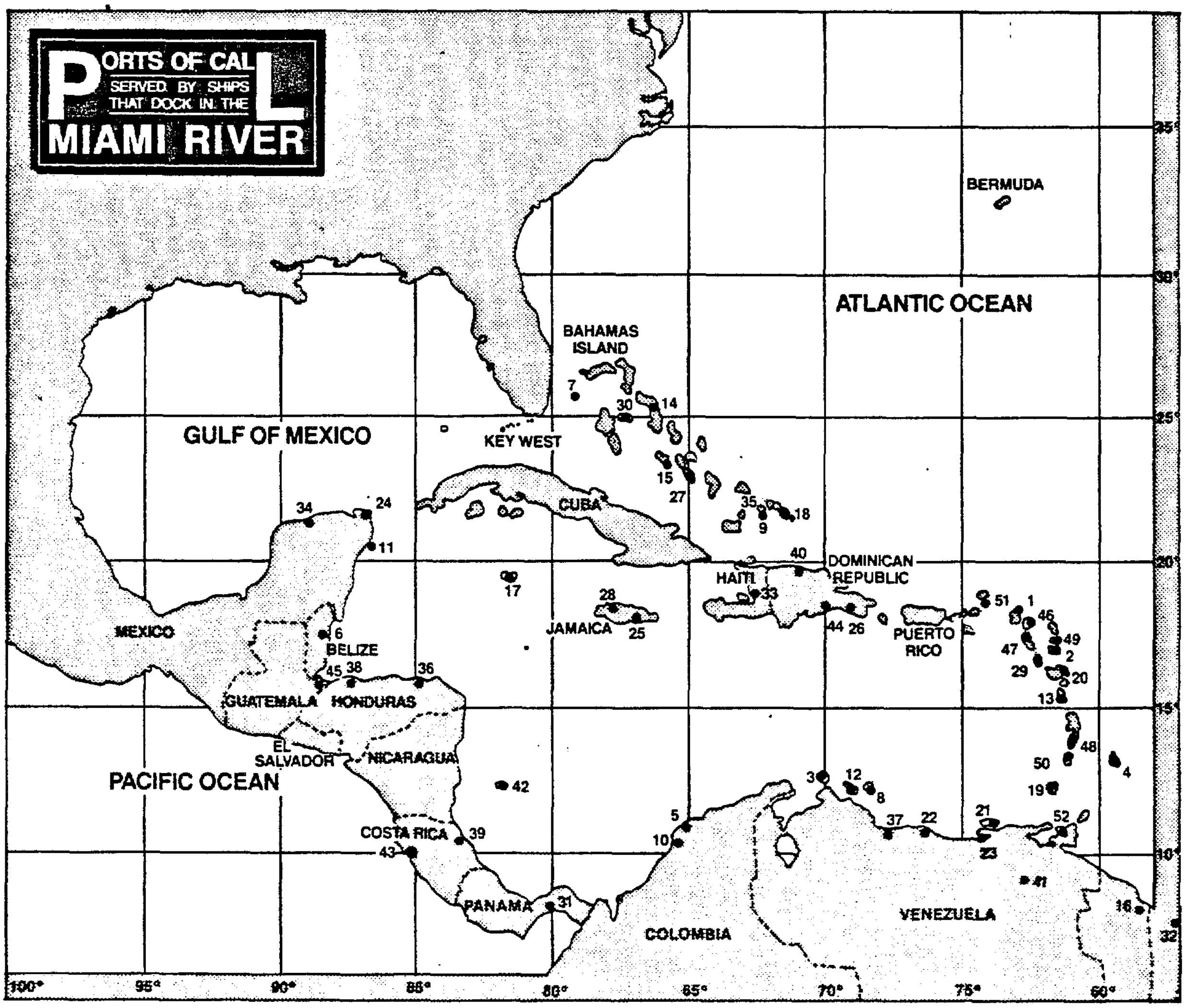


FIGURE 131

PORTS OF CALL

SOURCE: MIAMI SHIPPER MAGAZINE

TABLE 30

Miami River Cargo Terminals

Cargo Terminals/ Steamship Agents and Lines	Basin location	Address	Ports of Call	Vessel Calls Per Year	Annual Tons	Annual Value
Victoria Marine	A	111 SW 3 St.	Central America	25	25,000	$ 62,500,000.
Miami Ship Services	A	615 SW 2 Ave.	Nassau	110	27,500	68,750,000.
Bahamas International line	B	31 NW SRD	Bahamas, Turks & Caicos	—	—	—
Denizana	B	377 NW SRD	Haiti	156	71,400	71,400,000.
Hera Line	B	412 NW NRD	Haiti, Bahamas	--	--	--
Johnson Shipping	E	2974 NW SRD	S. America, Bahamas, Antigua	124	67,400	150,500,000.
Bernuth Marine Shipping	E	3163 NW SRD	West Indies	150	151,500	378,750,000.
Tri-Seas Marine	E	3301 NW SRD	Barbados, Guyana	60	--	--
Hyde Shipping Corporation	E	3030 NW NRD	Beliz, Honduras, Grand Cayman, Costa Rica	83	74,200	185,500,000.
Antillian Marine Shipping	E	3060 NW NRD	Haiti, Dominican Republic	130	143,200	358,000,000.
Pioneer Shipping	E	3250 NW NRD	Nassau	125	83,200	208,000,000.
South and Caribbean Agency	E	3611 NW SRD	West Indies, Panama	90	66,000	165,000,000.
CMT Line	E	3701 NW SRD	Belize, Guatemala	30	9,000	22,500,000.
TOTALS				1,078	594,500	$1,670,900,000.

Source: Miami River Businessmens Association, 1986.

The ten major shipping terminals on the River account for about 1,070 vessel departures per year. Average tonnage per ship ranges from 250 to 1,350 tons per voyage. The average number of vessel calls, annual tonnage and estimated annual value of cargo shipped from the ten major terminals on the Miami is summarized in Table 30.

To appreciate the value of the River terminals to the local economy one must also take into account dollars spent on food, fuel, ship and dock-side payroll, ship insurance cargo and workers liability, maintenance and repairs, tugs, container leasing and dry dockage. These expenditures amount to an estimated $20-$25 million for six of the major terminals on the River in Basin E. With the exception of the dry dockage figure most of these dollars are spent in Dade County (McNabb, personal communication, 1986).

Fish Houses

There are thirteen establishments along the Miami River that engage in fish processing, transshipment, or the sale of fish and seafood. This represents about one tenth of such establishments Countywide. This percentage is relatively low, because most of the establishments engaged in sale or shipment of fish or shellfish are located inland rather than at the shoreline. Together the fish houses, restaurants and terminals cover about one half mile of River frontage, almost entirely within Basin B. The number and location of these establishments has not changed significantly during the past decade.

There are only four other locations within the Biscayne Bay Aquatic Preserve where significant numbers of commercial fishing vessels are berthed. These are Haulover Park in Unit I, Watson Island in Unit VI, Virginia Key and Key Biscayne in Units VII and VIII and Dinner Key in Unit VIII.

Towing, Marine Salvage and Marine Construction

Marine contracting and towing operations are based along all segments of the River. Nearly one half of the marine towing companies in Dade County operate out of facilities on the Miami River, but only seven of the more than thirty marine contractors in Dade County have facilities on the River. All of the towing of freighters into and out of the River is done by one company, Backus Towing which is located just west of the 12th Avenue Bridge.

In contrast to the towing and marine construction facilities that are located along the River bank from the mouth to the salinity dam, the marine salvage facilities are clustered in Basin E. Six of the twenty-plus marine salvage facilities in the County are based in the area west of 27 Avenue. Together, these facilities cover less than one-quarter mile of Riverfront.

Marine Repair, Storage and Fueling Facilities

As indicated in Table 31, thirty-four commercial facilities along the banks of the Miami River and its tributaries provided marine repair, storage and fueling services in 1985. This represented about one-third of all marine repair facilities, and 17 of the 19 boat yards in Dade County. Altogether these facilities covered about four miles of shoreline on the River and its tributaries. About 20 percent of the River shore was devoted to marine repair and storage facilities in 1985. Twenty-one of those facilities provided about 650 wet slips (about 10 percent of the available slips in Dade County) and 100 dry racks. Two private facilities provided an additional 70 wet slips. Observation of aerial photographs showed that there were also over 430 vessels under 100' in length and 60 vessels over 100' docked along the River and tributary banks in February 1986. (Metro Dade Planning Department).

In the period from 1973-74 through 1984-85, four marine facilities were replaced by non-marine uses but an equal number of new marine facilities were opened in locations, that were formerly vacant or used for non-marine related activities. Twenty-four marine facilities operated under the same name, at the same location, in 1973-74 and 1984-85 (see Table 32).

Public Access

In addition to the water dependent uses discussed above, six shoreline parks and an equal number of provide some public access to the River area of the Aquatic Preserve. Three of the shoreline restaurants provide transient dockage for their customers.

The City of Miami owns almost a mile of shoreline along the River and its tributaries from Fort Dallas Park near the Hyatt Knight Center to River Rapids Park west of the 27th Avenue Bridge. The larger parks include Jose Marti, Lummus, Curtis, Sewell and Fern Island west of 22 Avenue on the South Fork. All of these areas are presently underutilized. Only Curtis, with its boat ramp, provides any direct physical access to the River.

Several of the park areas are steeped in history. As discussed in the introduction to this chapter, the Fort Dallas area is a significant site both in terms of archeology and local history. At the far end of the River, west of 27 Avenue, Paradise Park was renamed River Rapids Park in 1986 in honor of that site's place in history. To the east of the publicly owned park land there is a privately owned parcel that was the site of the Ferguson Brothers' comptie starch mill.

In addition to the major park lands along the River, there are twenty-two other publicly owned parcels along the River and its tributaries. These range from tiny right-of-ways adjacent to bridges, to parcels such as the right-of-ways under Metrorail and the parcel of land on the NE side of the 12th Street Bridge, which provide public access to the River's edge.

TABLE 31

Commercial Marinas/Boat Yards on the Miami River and Tributaries

Facility	Type	# Wet Slips	Dry Racks	# Years Site Used as Marina
Basin A				
Dupont Plaza	transient dockage			10+
Miami Shipyard Underwater Services	ship repair			45
Atlantic Marine	boat yard	8-10	2	40+
Miami River Yacht Repair	repair, sales & storage	12-20		10+
Quality Yacht/Dawsons Yacht Sales and Service	repair and sales			10+
Dawsons Marine Service	fuel, supplies & repair			10+
Basin B				
Bimini	boat yard & storage	10-12	surface storage	15+
Mario's Marine Service	boat yard & storage	25 (estimated)		10+
Tony's Marine Service	boat yard & storage	35		22
Basin C				
Anchor Marine	boat yard, boat & equip. sales & painting, Storage	10	15	18+
Eighth Avenue	commercial marina	32		35+
Blanco Marine Center	repair and towing		15	
River Port Marina	boat yard	7	10	
Merrill Stevens	ship repair/dry dock	35-45		100
Norseman	boat yard, painting			50+
Marlin Marine (Wagner Creek)	repair & sales of equipment & supplies			5
Rivas Marine Service (Wagner Creek)	repair & painting			

TABLE 31 (continued)

Facility	Type	# Wet Slips	Dry Racks	# Years Site Used as Marina
Basin D				
Allied Marine (South Fork)	boat yard, boat & equip. sales & boat storage	25	7	30+
Best Yacht Repair	yacht building, repairing, painting	4		5
Florida Yacht Basin	boat yard, painting and storage	30-35	5	15+
Hardie's	marina	87-100		40
Nuta's	boat yard, painting and storage, do it yourself	125	surface storage	95
Poland	boat yard, painting, do it yourself	20-25		50
Lorequin	builder			
Oasis	repair			
B. Sugar	storage			
Basin E				
Auto Marine Engineers	Closed 1986			50+
Defender Yacht (Palmer Lake)	builder	5		
Jones Boat Yard	boat yard & storage		65	60+
Echo Marine Service	repair and painting			
South River Propeller Repair	repair			
Tamiami Canal				
Richard Bertram	boat builder, boat yard, sales & storage	85-100		
Tamiami Marine/ Friendly Marine/ United Marine Resources	boat yard, yacht repairs & surveys	13	4	7
Bojean Boat Yard/ Marine Discount Store	boat yard/do it your-, self, sales		25	
TOTAL		618-678	88-98 plus surface storage	

TABLE 32

Boat Building, Repair, Storage and Marine Fueling Facilities on the Miami River 1973-85

	# Facilities 1973-74	# Facilities 1984-85	Changes 1973-74 Compared to 1984-85
Basin A	8	8	5 = Same business at same location 3 = Marine use, at location 1973-74 and 1984-85
Basin B	9	7	4 = Same business at same location 3 = Marine use at location 1973-74 and 1984-85 2 = Marine use 1973-74; non-marine use 1984-85
Basin C (plus Wagner Creek)	7	8	4 = Same business at same location 3 = Marine use at location 1973-74 and 1984-85 1 = Non-marine use 1973-74; marine use 1984-85
Basin D	12	12	7 = Same business at same location 3 = Marine use at location 1973-74 and 1984-85 2 = Marine use at location 1973-74; non-marine use at location 1984-85 2 = Non-marine use at location 1973-74; non-marine use at location 1984-85
Basin E (including Tamiami Canal and Palmer Lake	5	6	4 = Same business at same location 1 = Non-marine use at location 1973-74 and 1984-85 1 = Marine use 1973-74; marine use at location 1984-85
	41	41	

IMPACTS ON RIVER UTILITY

For several decades the use of the River was constrained by the unkempt appearance of several shoreline areas, deteriorating structures, trash and litter, pollution and crime. As discussed previously, in both 1973 and 1984, people who live and work along the River claimed that crime and pollution were the major problems in the vicinity of the Miami River. The general disregard for this valuable resource was easily confirmed by merely taking a trip up the River.

The public's appreciation and use of the River has been further limited by subdivision and development patterns and road and bridge alignments. The bridges over the Miami could provide opportunities for viewing the River, however, except for the higher, newer bridges these structures provide very little public amenity. For example, the 12th Avenue Bridge cuts the small publicly owned parcel on the northeast side of the River off from the Government Center area to the west, and on the south side of the River the bridge's approach separates the lands abutting the River from the rest of the neighborhood. There are small parcels of publicly owned land adjacent to the Flagler and 27th Avenue bridges, but road and bridge alignments isolate these areas and keep them from being reached or used by the public.

The alignment of North and South River Drives severely constrains the possibilities for Riverfront use and redevelopment, particularly in Basin B on the south side of the River. However, the alignment of North River Drive in Basin B and in Basin C west of 12 Avenue, and South River Drive west of the 27 Avenue, provides some opportunities for passing motorists to catch a glimpse of the life and activities along the River. North River Drive also bisects Lummus and Curtis parks, cutting the activities in the non-River side of these parks off from the water's edge. In most other locations along the River, subdivision and land uses have evolved into patterns that severely limit public, physical or visual access to the River.

Many commercial enterprises on the Miami River have been in the same location for several decades. Similarly, in some of the older neighborhoods there has been little change in the land use patterns for many years. These long-standing land use patterns have created a cadre of people who are loyal to the River and who understand it well. However, citizens from the greater Miami and Dade County area have generally been apathetic and have regarded the River as a place to be avoided unless they have needed boat repairs, marine services or hurricane storage.

During the past decade, several marine interest groups have been concerned that marine industries and activities were slowly being pushed away from the River, or out competed by similar activities in Broward and Monroe Counties. Concern has also been voiced about the effect of River bridge openings on Riverside uses and activities. However, several of the shipping terminals at the western end of the River have expanded their operations during the past decade and some have moved their offices, warehousing and storage activities to non-shoreline locations as they have needed more space. In recent years, there has also been a rapid expansion of car rental storage and parking areas in the western end of the River just east of the Miami International Airport. There is concern that these nonmarine activities will constrain further expansion of the shipping activities in Basin E.

As discussed in Chapter 1, the River is recognized as the prime location in Dade County for hurricane storage. There is concern in the marine community and among hurricane and emergency preparedness experts that the River and its tributaries cannot accommodate all the boats people expect to place there during a hurricane. There is an even greater concern that many boat owners have made no plans for what they will do or where they will go in the event of a hurricane.

What is Being Done

During the period of the Miami River Management and Coordinating Committees' activities from 1984-86, the River once again became the focus of public attention and citizen concern. The effects of Senator Chiles efforts have been discussed previously. As of early 1986, the River appearance had improved significantly as over one hundred seized vessels had been cleared from its banks, and several shoreline areas had been improved with new bulkheads and docks.

Under the auspices of the River Committee, several other steps were taken to heighten concern for the River's problems and to improve public awareness of the River's unique and important place in Dade County's history and future development. The River bridges were painted in rainbow colors and historic markers were erected at appropriate Riverside locations. Design competitions were sponsored by the University of Miami School of Architecture to heighten awareness of design problems and potential solutions. The River Committee cooperated with Dade County in lobbying for funds for full-time pollution control inspection and law enforcement presence on the River. Together with the County and the City of Miami, the Committee continued to seek a commitment from the U.S. Army Corps of Engineers to dredge the sediments from the River.

In response to the concern that marine dependent businesses along the River were being displaced by nonmarine land uses, the City of Miami initiated an economic study of Riverfront activites and uses to obtain a better understanding of the River's place in Dade County's and south Florida's economic picture. River businesses were surveyed and a comprehensive data base was assembled about shoreline conditions, the Riverside environment, land uses and constraints to further Riverside development. These data will be used by both the City and the County in their planning and management activities along the River corridor.

During 1985-86, Metro-Dade County was engaged in a study of the Melrose area from 27 Avenue west to LeJeune Road and from the Airport Expressway on the north to NW 20 Street on the south. This study area includes shipping terminals, freight forwarding activities and the essential links with rail, highway, air, and transportation modes. These activities exist in close proximity to scrap metal yards, nonmarine industrial uses, warehousing, parking and residential uses. This study will address future land use priorities in this key transshipment area.

The City of Miami has jurisdiction over land use planning, zoning and building activities along the four miles of the Miami River east of 27 Avenue. The City will use the information garnered from the economic study to develop long range plans for this area. During 1985-86, the City prepared a development plan for the downtown area which includes the Riverfront area east of NW 5 Street. When the City's Public Works Department announced plans to do road paving and drainage work on North River Drive between NW 2 Avenue and NW 5 Street, the City's Planning Department developed a landscape plan with decorative sidewalk paving. It is expected that this work will be completed in 1987.

Elsewhere along the Riverfront, Magic City Enterprises developed a plan to renovate several of the homes bordering NW 1 Street as bed and breakfast establishments. Daily tours of the River were given on the Island Queen, and the fifth annual Riverfest (formerly River Revival) featured a farmers market, a River run, treasure hunt and fish fry in October 1986.

In 1986, both the City of Miami and Metro-Dade County approved the establishment of a permanent Miami River Coordinating Committee. The members of this committee will include three State representatives; four City representatives, including the City Manager and three citizens appointed by the City Commission; and four County representatives, including the County Manager and three citizens appointed by the County Commission. The establishment and makeup of this committee constitute a significant step toward bringing River management into focus as a priority for these local governments.

While all of the above activities point to a dramatic turn in public opinion regarding the River and its place in Dade's history and economy, the job is far from done. It will take time and several million dollars to complete the task of bringing the Miami River back to its rightful place at the heart of Dade County. The recommendations listed below address many important steps which should be taken to improve the quality and utility of the Miami River. They have been reviewed by the Miami River Coordinating Committee.

RECOMMENDATIONS TO IMPROVE THE QUALITY OF THE MIAMI RIVER

* <u>Storm Water Outfalls</u>. The Miami River Coordinating Committee (MRCC) should encourage and support additional Countywide and Citywide bond issues to upgrade all the storm water drainage systems that discharge into the Miami River and its tributaries.

* <u>Combined Sewage/Storm Water Overflows</u>. The MRCC should seek State, County and City funds to redesign and refit the sewage pump stations within the River storm water drainage basins to eliminate combined sewage/storm water overflows during peak rain conditions.

* <u>Dredging</u>. The State of Florida, Dade County, the City of Miami and the Miami River Coordinating Committee should work to obtain the required matching funds for removing the sediments from the Miami River.

* <u>Sewage Pump Out Facilities</u>. Rules should be promulgated by Federal, State, County and municipal governments requiring sewage pump out facilities at all shipping terminals and dockage facilities.

* <u>Seybold Canal</u>. A monitoring and enforcement, campaign should be undertaken in the Seybold Canal and Civic Center hospital area.

* <u>Code Enforcement</u>. The Miami River Coordinating Committee should call together all entities involved in Code Enforcement to explain their area of jurisdiction and recent actions vis-a-vis enforcement along the River, and to suggest actions to expedite code enforcement activities.

* <u>Code Enforcement</u>. The Miami River Coordinating Committee, or its successor, should initiate a quarterly code enforcement "sweep" of the River area.

* <u>Shoreline Stabilization</u>. If riprap is not feasible along the River shoreline where coastal construction permits would normally require it, the riprap should be placed at a publicly owned and eroding sites along the River.

* <u>River Hotline</u>. A River "hotline" should be established to coordinate inquiries about River problems.

* <u>Boat Yards</u>. The MRCC should publicize facilities which use enclosures or sealed off areas for boat repairs, painting and scraping.

RECOMMENDATIONS TO IMPROVE THE UTILITY OF THE RIVER

* Public Awareness. The Miami River Coordinating Committee (MRCC) should begin a public awareness campaign in order to alleviate poor upland conditions which affect the utility of the River.

* Shoreline Stabilization. The State, County, City and MRCC should seek funds to stabilize the shoreline at several park lands including Curtis and Sewell Parks and the right-of-way east of the east/west expressway.

* Greening of the Miami River. The MRCC should continue to pursue a program for "Greening of the Miami River" by seeking funds to develop a master landscaping plan for several of the larger publicly owned parcels along the River.

* Landscaping. The County tree relocation program (part of DERM's tree removal permit process) should be utilized in order to landscape public and private Riverfront properties.

* Revegation and Landscaping. The City Parks Department should work with interested garden clubs and other volunteer organizations in reestablishing the hammocks and other landscaping in their Riverfront Parks.

* Use of Public Property. The City and County should reassess their policies regarding uses on publicly owned and leased properties along the River.

* Street End. The end of NW 32 Avenue on the north bank of the Tamiami Canal should be redesigned and used as a public access point. The feasibility of installing a canoe launch at this site should be evaluated.

* Marine Industrial/Commercial Zoning. Dade County should investigate the feasibility of establishing a Marine Industrial/Commercial Zone along the River bank west of 27 Avenue.

* Marine Industrial Park. The City of Miami and Dade County should investigate the feasibility of creating a marine industrial park west of 17 Avenue on the River.

* Riverfront Planning and Design. The City of Miami should continue its creative approach to Riverfront planning and design, especially in the Wagner Creek to 12 Street area.

* Archeological Reconstruction Sites. The State, County and City should use all reasonable means to acquire the parcel of land adjacent to River Rapids Park for reconstruction of this significant archeological/historic site.

* Fern Island Park. The City of Miami should cleanup the shoreline area on the western side of Fern Island Park and assess the feasibility of using this area for canoe launching.

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